

**NUCLEIC ACID MOLECULES AND OTHER MOLECULES ASSOCIATED WITH  
THE CARBON ASSIMILATION PATHWAY**

**CROSS REFERENCE TO RELATED APPLICATIONS**

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BI This application claims priority under 35 U.S.C. § 119(e) of application No. 60/076,712  
filed March 6, 1998, the entirety of which is herein incorporated by reference.

**FIELD OF THE INVENTION**

The present invention is in the field of plant biochemistry. More specifically the invention relates to nucleic acid sequences from plant cells, in particular, nucleic acid sequences from maize and soybean plants associated with the carbon assimilation pathway in plants. The invention encompasses nucleic acid molecules that encode proteins and fragments of proteins. In addition, the invention also encompasses proteins and fragments of proteins so encoded and antibodies capable of binding these proteins or fragments. The invention also relates to methods of using the nucleic acid molecules, proteins and fragments of proteins and antibodies, for example for genome mapping, gene identification and analysis, plant breeding, preparation of constructs for use in plant gene expression and transgenic plants.

**BACKGROUND OF THE INVENTION**

**I. INTRODUCTION**

The primary sites of photosynthetic activity, generally referred to as "source organs", are mature leaves and to a lesser extent, other green tissues (*e.g.*, stems). Photosynthesis may be broadly divided into two phases: a light phase, in which the electromagnetic energy of sunlight is trapped and converted into ATP and NADPH, and a dark or synthetic phase, in which the ATP and NADPH generated by the light phase are used, in part, for biosynthetic carbon reduction. In most plants, the major products of photosynthesis are starch (transitory storage form of

carbohydrate formed in chloroplasts), and sucrose (formed in the cytosol). Sucrose represents the predominant form of carbon transport in higher plants. Processes that play a role in plant growth and development, crop yield potential and stability, and crop quality and composition include: enhanced carbon assimilation, efficient carbon storage, and increased carbon export and partitioning.

Oxygen-evolving organisms are reported to have a common pathway for the reduction of CO<sub>2</sub> to sugar phosphates. This pathway is known as the reductive pentose phosphate (RPP), Calvin-Benson or C<sub>3</sub> cycle (Calvin and Bassham, *The Photosynthesis of Carbon Compounds*, Benjamin, New York (1962); Bassham and Buchanan, In: *Photosynthesis*, Govindjee, ed., Academic Press, New York, 141-189 (1982), both of which are herein incorporated by reference). A number of plants exhibit adaptations in which CO<sub>2</sub> is first fixed by a supplementary pathway and then released in cells in which the RPP cycle operates. From the point of view of the metabolic pathway operating for photosynthetic carbon assimilation, higher plants can be classified by the existence of supplemental pathway such as C<sub>3</sub>, C<sub>4</sub>, and crassulacean acid metabolism species (Edwards and Walker, *C<sub>3</sub> - C<sub>4</sub>: Mechanism and cellular and environmental regulation of photosynthesis*, Blackwell Scientific Publications, Oxford, (1983), herein incorporated by reference in its entirety).

The RPP pathway is reported to be the main route by which CO<sub>2</sub> is ultimately incorporated into organic compounds in all species of higher plants (Edwards and Walker, *C<sub>3</sub> - C<sub>4</sub>: Mechanism and cellular and environmental regulation of photosynthesis*, Blackwell Scientific Publications, Oxford, (1983); Macdonald and Buchanan, In: *Plant Physiology, Biochemistry and Molecular Biology*, Dennis and Turpin, eds., J. Wiley & Sons, Inc., New York, p. 239 (1990), herein incorporated by reference in its entirety; Robinson and Walker, In: *The*

*Biochemistry of Plants*, Vol. 8, Hatch and Boardman, eds., Academic Press, New York, p. 193 (1981), herein incorporated by reference in its entirety). In C3 plants, the RPP pathway is the sole route for photosynthetic carbon assimilation, whereas in C4 and CAM plants an additional (not alternative) method of carbon fixation, is present separated in space (C4 plants) or in time (CAM plants) from the RPP cycle (Edwards and Walker, C3 - C4: *Mechanism and cellular and environmental regulation of photosynthesis*, Blackwell Scientific Publications, Oxford, (1983)). Carbon skeletons are required to incorporate other functional groups, the operation of the RPP cycle for photosynthetic CO<sub>2</sub> fixation is a requisite for the biochemical synthesis of carbohydrates, lipids, proteins, and nucleic acids.

## II. THE REDUCTIVE PENTOSE PHOSPHATE CYCLE

The RPP cycle is reported to be the primary carboxylating mechanism in plants. Enzymes which catalyze steps in the RPP cycle are water soluble and are located in the soluble portion of the chloroplast (stroma). Reviews on the mechanism and enzymes involved in the RPP cycle include: Bhagwat, In: *Handbook of Photosynthesis*, Pessaraki, ed., Marcel Dekker Inc, New York, 461-480 (1997), herein incorporated by reference in its entirety; Iglesias *et al.*, In: *Handbook of Photosynthesis*, Pessaraki, ed., Marcel Dekker Inc, New York, 481-503 (1997), herein incorporated by reference in its entirety; Robinson and Walker, In: *The Biochemistry of Plants*, Vol. 8, Hatch and Boardman, eds., Academic Press, New York, 193-236 (1981); Macdonald and Buchanan, In: *Plant Metabolism*, Dennis *et al.*, eds., Longman, Essex, England, 299-313 (1997).

The RPP pathway is an autocatalytic pathway for the *de novo* synthesis of carbohydrates from inorganic CO<sub>2</sub>. The RPP cycle is reported to comprise three phases. The first phase of the cycle is the carboxylation phase, during which ribulose-1,5-bisphosphate (Rbu-1,5-P<sub>2</sub>) is

carboxylated to produce two molecules of 3-phosphoglycerate (3-PGA). The next phase is the reductive phase during which ATP and NADPH produced by the light reaction of photosynthesis are consumed in the reduction of 3-PGA to glyceraldehyde-3-phosphate (GA-3-P). The RPP cycle is completed by the regeneration phase where intermediates formed from GA-3-P are utilized via a series of isomerizations, condensations and rearrangements, resulting in the conversion of five molecules of triose phosphate to three molecules of pentose phosphate, and eventually ribulose 5-phosphate (Rbu-5-P). Phosphorylation of Rbu-5-P by ATP regenerates the original carbon acceptor Rbu-1,5-P<sub>2</sub>, thus completing the cycle.

The RPP cycle is a metabolic pathway common to all photosynthetic organisms. Many of the enzymes of the metabolic route, as well as proteins involved in metabolite transport and regulation, have been purified.

Ribulose biphosphate carboxylase (Rubisco, also referred to as ribulose-1,5-bisphosphate carboxylase/oxygenase (EC 4.1.1.39)) constitutes about 50% of the total soluble protein in green leaves. Ribulose biphosphate carboxylase is reported to provide a quantitative link between the pools of inorganic and organic carbon in the biosphere. Ribulose biphosphate carboxylase catalyses the conversion of atmospheric carbon dioxide into three carbon compounds.

Subsequent reactions result in both regeneration of the acceptor molecule and translocation of three molecules of triose-phosphate to the cytosol for synthesis of sucrose and starch. Reviews of the ribulose biphosphate carboxylase enzyme are provided by Ellis, *Trends Biochem. Sci.* 4: 241-244 (1979); Hartman and Harpel, *Annu. Rev. Biochem.* 63: 197-234 (1994); Miziorko and Lorimer, *Annu. Rev. Biochem.* 52: 507-535 (1983); Andrews and Lorimer, In: *The Biochemistry of Plants*, Vol 10, Hatch and Boardman, eds., Academic Press, San Diego, p. 131 (1987); Jensen, In: *Plant Physiology, Biochemistry, and Molecular Biology*, Dennis and Turpin, eds., J. Wiley &



Sons, Inc., New York, p 224 (1990), all of which are herein incorporated by reference in their entirety.

Plants are reported to have two phosphoglycerate kinase isoenzymes (EC 2.7.2.3), one in the chloroplast and the other in the cytosol. The two isoenzymes are antigenically related, but can be distinguished on the basis of their isoelectric point (pI) values and on the basis of their affinity for magnesium and other substrates (Anderson and Advani, *Plant Physiol.* 45:583-585 (1970); Kopke-Secundo *et al.*, *Plant Physiol.* 93:40-47 (1990), both of which are herein incorporated by reference in their entirety).

Three different glyceraldehyde 3-phosphate dehydrogenase (GAPDH (EC 1.2.1.13)) enzymes are found in eukaryotic cells (Pupillo and Faggiani, *Arch. Biochem. Biophys.* 194: 581-592 (1979); Iglesias, *Biochem. Educ.* 18: 2-5 (1990), both of which are herein incorporated by reference in their entirety). In higher plants there are two chloroplast GAPDH subunits: GapA (36 kDa) and GapB (42 kDa). The functional enzyme is reported to be a tetramer with either an A<sub>4</sub> or an A<sub>2</sub>B<sub>2</sub> subunit structure (Cerff, In: *Methods in Chloroplast Molecular Biology*, Edelman, ed., Elsevier Press, Amsterdam: 683 (1982), the entirety of which is herein incorporated by reference). Sequence analysis of tobacco cDNA clones encoding the GapA and GapB subunits has revealed that they are homologous (Shih *et al.*, *Cell* 47: 73-83 (1986), the entirety of which is herein incorporated by reference). The three-dimensional structure of GADPH from both eukaryotes and prokaryotes has been studied, and it seems that the initial binding of the NAD coenzyme triggers a number of structural changes (Skarzynski and Wonacott, *J. Mol. Biol.* 203: 1097-1118 (1988), the entirety of which is herein incorporated by reference).

Chloroplastic triose phosphate isomerase (TPI (EC 5.3.1.1)) is a homodimer with a subunit molecular weight of about 27 kDa (Pichersky and Gottlieb, *Plant Physiol.* 74: 340-347

(1984), the entirety of which is herein incorporated by reference). The chloroplastic enzyme is reported to be distinguishable from the cytosolic enzyme by isoelectric focusing and peptide digestion mapping (Pichersky and Gottlieb, *Plant Physiol.* 74: 340-347 (1984); Kurzok and Feierabend, *Biochim. Biophys. Acta* 788: 222-233 (1984), herein incorporated by reference in its entirety). TPI, like several other RPP cycle enzymes, binds the substrate in a pocket, which is then reported to be closed by a flexible loop which acts to shield the substrate from attack by water. Even though the active site is formed by residues from one subunit, the second subunit helps to exclude water from the active site domain.

Two reactions of the RPP cycle involve aldolase (EC 4.1.2.13), and both are catalyzed by the same enzyme, which is a tetramer of the 38 kDa subunit. It has been reported that each subunit of aldolase has a beta/alpha barrel structure (Sygusch *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 84:7846-7850 (1987), the entirety of which is herein incorporated by reference) and that the C-terminal region covers the active site pocket, which is in the barrel and regulates access to the active site pocket.

Fructose-1,6-bisphosphatase (FBPase) (EC 3.1.3.11) is a homotetramer with a molecular weight of about 160 kDa. The amino acid sequence is reported to be highly conserved (Raines *et al.*, *Nucleic Acid Res.* 16: 7931-7942 (1988), the entirety of which is herein incorporated by reference). In both wheat and spinach, 12 extra amino acid residues have been identified that seem to be involved in the regulation by light via the ferredoxin/thioredoxin system (Raines *et al.*, *Nucleic Acid Res.* 16: 7931-7942 (1988); Marcus *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 85:5379-5383 (1988), the entirety of which is herein incorporated by reference).

Transketolase (EC 2.2.1.1) (152 kDa tetramer) is found in cytosolic and chloroplastic forms. These forms are reported to have similar properties except for their response to  $Mg^{2+}$

(Feierabend and Gringel, *Zeitschrift für Pflanzenphysiol.* 110:247-258 (1983); Murphy and Walker, *Planta* 155: 316-320 (1982), both of which are herein incorporated by reference in their entirety).

Sedoheptulose-1,7-bisphosphate phosphatase (SBPase (EC 3.1.3.37)) is not reported to have a cytosolic counterpart and is reported to be found only in the chloroplast. The enzyme is reported to be a homodimer with a subunit molecular weight of 35-38 kDa (Nishizawa and Buchanan, *J. Biol. Chem.* 256: 6119-6126 (1981); Cadet and Meunier, *Biochem. J.* 253: 243-248 (1988), both of which are herein incorporated by reference in their entirety).

D-ribulose-5-phosphate-3-epimerase (EC 5.1.3.1) has been reported in animals as a homodimer with a subunit molecular weight of 23 kDa (Karmali *et al.*, *Biochem. J.* 211:617-623 (1983), the entirety of which is herein incorporated by reference).

Ribose-5-phosphate isomerase (EC 5.3.1.6) has been purified from tobacco and spinach and is reported to be a homodimer with a subunit molecular weight of 26 kDa (Rutner, *Biochemistry* 9: 178-184 (1970); Babadzhanova and Bakaeva, *Biokhimiya* 53: 134-140 (1987), both of which are herein incorporated by reference in their entirety).

### III. REGULATION OF C3 PHOTOSYNTHESIS

The regulatory properties of the RPP cycle have been reported by Edwards and Walker, C3 - C4: *Mechanism and Cellular and Environmental Regulation of Photosynthesis*, Blackwell Scientific Publications, Oxford, (1983); Leegood, *Photosynthesis Res.* 6: 247-259 (1985), herein incorporated by reference in its entirety; Woodrow, *Biochim. Biophys. Acta* 851:181-192 (1986), the entirety of which is herein incorporated by reference. The conservation of phosphate is reported to play a role in the regulation of C3 photosynthesis, as a change in the level of any phosphorylated intermediate is balanced by an equal and opposite change in terms of phosphate

elsewhere in the cycle (Woodrow, *Biochim. Biophys. Acta.* 851:181-192 (1986); Fell and Sauro, *Eur. J. Biochem.* 148: 555-561 (1985), herein incorporated by reference in its entirety).

Therefore, changes in the activity of any of the RPP cycle enzymes can affect both the substrate concentration and activities of other enzymes in the chloroplast.

#### IV. THE C<sub>4</sub> PATHWAY OF CARBON ASSIMILATION

In the C<sub>4</sub> pathway, CO<sub>2</sub> is concentrated in bundle sheath cells at the site of the RPP cycle initiated by ribulose biphosphate carboxylase. C<sub>3</sub> photosynthesis is documented to be the only mode of carbon assimilation in algae, bryophytes, pteridophytes, gymnosperms, and the majority of angiosperm families. Only about 10 families of known monocots and dicots have been reported to possess the C<sub>4</sub> pathway of photosynthesis, these include, for example, *Zea mays*, sorghum, sugar cane, etc. The C<sub>4</sub> pathway has been reviewed by, for example, Edwards *et al.*, In: *CO<sub>2</sub> Metabolism and Productivity of Plants*, Burris and Black, eds., University Park Press, Baltimore, MD, p.83 (1976); Hatch, *Biochim. Biophys. Acta* 895: 81-106 (1987); Ashton *et al.*, In: *Methods In Plant Biochemistry*, Vol. 3, Academic Press Limited, New York, p.39 (1990), all of which are herein incorporated by reference in their entirety. A feature reported to be common to the enzymes in the C<sub>4</sub> pathway is that their activities are 15-100 times higher compared to those reported in C<sub>3</sub> plants. For example, adenylate kinase and pyrophosphatase activities are reported to be 20-50 times higher in C<sub>4</sub> plants than in C<sub>3</sub> plants. Adenylate kinase and pyrophosphatase are largely located in the mesophyll chloroplast together with pyruvate Pi dikinase (Slack *et al.*, *Biochem. J.* 114: 489-498 (1969), herein incorporated by reference in its entirety).

In certain plant types (*e.g.*, *Zea mays*, sorghum and sugar cane), CO<sub>2</sub> is initially assimilated in mesophyll cells (with PEP acting as a primary acceptor of CO<sub>2</sub>) as oxaloacetate,

which is reduced to malate by NADP-malate dehydrogenase. It has been reported that malate is moved to bundle sheath cells. In the chloroplast of bundle sheath cells, malate is decarboxylated by NADP-malic enzyme (malate formers) giving rise to pyruvate, and releasing CO<sub>2</sub> and NADPH. NADPH can be cycled back to NADP by coupling to PGA reduction in the RPP cycle. The carbon formed moves back to the mesophyll cells where it is converted to PEP by pyruvate Pi dikinase.

Plants of the PEP carboxykinase type are reported to have higher activities of aspartate and alanine aminotransferases than the malate formers. Such plants are reported to be aspartate formers rather than malate formers. In aspartate formers, the activity of PEP carboxykinase is reported to be higher and the activity of NADP-malic enzyme is reported to be lower (Edwards and Black, In: *Photosynthesis and Photorespiration*, Hatch *et al.*, eds., Wiley Interscience, New York, p.153 (1971), the entirety of which is herein incorporated by reference). It has been reported that the PEP carboxykinase is located in the cytosol of bundle sheath cells.

This group of C<sub>4</sub> plants is not reported to contain either high levels of NAD-malic enzyme activity or high levels of PEP carboxykinase. It has been reported by Hatch and Kagawa (*Aust. J. Plant Physiol.* 1: 357-369 (1974), the entirety of which is herein incorporated by reference) that these plants contain high NAD-malic enzyme activity in mitochondria and that the number of mitochondria in these plants may be increased by a factor of 3-4.

## **V. ENZYMES INVOLVED IN THE C<sub>4</sub> PATHWAY**

Phosphoenolpyruvate carboxylase (PEP carboxykinase (EC 4.1.1.31)) is reported to initiate the carboxylative phase of the C<sub>4</sub> metabolic route by catalyzing the irreversible beta-carboxylation of PEP. The reaction utilizes a divalent metal ion (*e.g.*, Mg<sup>2+</sup>) as a cofactor. In C<sub>4</sub> plants, PEP carboxykinase is reported to play a role in catalyzing the initial fixation of

atmospheric CO<sub>2</sub> in the cytoplasm of mesophyll cells (O'Leary, *Annu. Rev. Plant Physiol.* 33: 297-315 (1982); Andreo *et al.*, *FEBS Lett.* 213: 1-8 (1987), both of which are herein incorporated by reference in their entirety). PEP carboxykinase from C4 plants is reported to be a homotetramer with molecular weight of 400 kDa (O'Leary, *Annu. Rev. Plant Physiol.* 33: 297-315 (1982); Andreo *et al.*, *FEBS Lett.* 213: 1-8 (1987)). Each subunit is reported to contain at least one substrate-binding site. The monomeric form is reported to be inactive (Wagner *et al.*, *Eur. J. Biochem.* 173: 561-568 (1988); Walker *et al.*, *Plant Physiol.* 80: 848-855 (1986); Wagner *et al.*, *Eur. J. Biochem.* 164: 661-666 (1987), all of which are herein incorporated by reference in their entirety).

In C4 plants, PEP carboxykinase is reported to be allosterically regulated. Glucose-6-phosphate, triose-phosphate and Pi are reported to be activators, and malate is reported to be an inhibitor of enzyme activity. C4 PEP carboxykinase is also reported to be subject to light regulation. Responses to light/dark involve a post-translational modification of the enzyme (Jiao and Chollet, *Plant Physiol.* 95: 981 (1991), herein incorporated by reference in its entirety). The PEP carboxykinase is phosphorylated, during the light phase, at a serine residue close to the N-terminal region of the enzyme (Ser-15 in *Zea mays*) (Jiao and Chollet, *Plant Physiol.* 95: 981 (1991)). The phosphorylation is reported to be catalyzed by a soluble protein-serine kinase. The phosphorylated form of PEP carboxykinase is reported to be less sensitive to malate inhibition.

NADP-dependent malate dehydrogenase (NADP-MDHase (EC 1.1.1.82)) is reported to be located in the chloroplast of mesophyll cells and is reported to reduce oxaloacetate (OAA) by using photosynthetically generated NADPH. The native enzyme is reported to be a dimer composed of a nuclear-encoded subunit of molecular mass 42 kDa (Jenkins *et al.*, *Plant Sci.* 45: 1-7 (1986); Kagawa and Bruno, *Arch. Biochem. Biophys.* 260: 674-695 (1988), both of which are

herein incorporated by reference in their entirety). In C<sub>4</sub> plants, NADP-MDHase is reported to have an alkaline pH optimum and the reduction of OAA is reported to be inhibited by NADP<sup>+</sup>. NADP-MDHase is reported to be light regulated with the enzyme active during the light phase and inactive during the dark phase. The activation mechanism involves reversible thiol/disulfide interchanges mediated by ferredoxin and thioredoxin m. The reaction is promoted under conditions of high NADPH:NADP<sup>+</sup> ratio in the chloroplast stroma.

Aspartate aminotransferase (EC 2.6.1.1) is a cytoplasmic enzyme that converts OAA and glutamate into aspartate and alpha-ketoglutarate (alpha-KG) in mesophyll cells (Taniguchi *et al.*, *Arch. Biochem. Biophys.* 282: 427-432 (1990); Rastogi *et al.*, *J. Bacteriol.* 173: 2879-2887 (1991); Reynolds *et al.*, *Plant Mol. Biol.* 19: 465-472 (1992); Kirk *et al.*, *Plant Physiol.* 105: 763-764 (1994); Schultz *et al.*, *Plant J.* 7: 61-75 (1995), all of which are herein incorporated by reference in their entirety). Aspartate is exported into bundle sheath cells where decarboxylation takes place. Aspartate aminotransferase is reported to be present in aspartate forming C<sub>4</sub> plants.

Alanine aminotransferase (EC 2.6.1.2) is reported to be present in C<sub>4</sub> plants of the NAD-dependent malic acid enzyme (NAD-ME) type and interconverts in a reversible reaction the metabolites pyruvate and alanine in the cytoplasm of both mesophyll and bundle sheath cells (Son *et al.*, *Plant Mol. Biol.* 20: 705-713 (1992); Umemura *et al.*, *Biosci. Biotechnol. Biochem.* 58: 283-287 (1994), both of which are herein incorporated by reference in their entirety). The amino acid alanine is a metabolite transported in this C<sub>4</sub> subtype.

NADP-dependent malic enzyme (NADP-ME (EC 1.1.1.40)) is reported to be present in NADP-ME type C<sub>4</sub> plants and is located in the chloroplasts of bundle sheath cells. NADP-ME catalyses the conversion of malate into pyruvate and CO<sub>2</sub> in the presence of NADP<sup>+</sup>. This reaction is reported to require a metal ion (Ashton *et al.*, In: *Methods in Plant Biochemistry*, Lea,

ed., Academic Press, New York, p. 39 (1990); Leegood and Osmond, In: *Plant Physiology, Biochemistry and Molecular Biology*, Dennis and Turpin, eds., Wiley & Sons, Inc., New York, p.274 (1990), herein incorporated by reference in its entirety). The NADP-ME enzyme in C<sub>4</sub> plants is reported to comprise a single subunit with molecular weight of 62 kDa. At least two plastidic isoforms of NADP-ME, "dark" form and "light" form (the light form is also known as the "green" form), have been reported in *Zea mays* leaves (Andreo *et al.*, In: *Proceedings of the International Congress on Photosynthesis*, Montepelier, France, Mathis, ed., Kluwer Academic Publishers, Amsterdam, (1995), the entirety of which is herein incorporated by reference). The dark form of the NADP-ME, which is present mainly in etiolated *Zea mays* leaves, has a molecular weight of 72 kDa and a lower specific activity compared to the "green" form of NADP-ME (62 kDa) found in green leaves (Andreo *et al.*, In: *Proceedings of the International Congress on Photosynthesis*, Montepelier, France, Mathis, ed., Kluwer Academic Publishers, Amsterdam, (1995)). The "green" form of NADP-ME appears to be enhanced by light. The dark form of the enzyme resembles the NADP-MEs found in C<sub>3</sub> plants in both photosynthetic and nonphotosynthetic tissues.

NAD-dependent malic enzyme (NAD-ME (EC 1.1.1.39)) is reported to be located in the mitochondria where it catalyzes the NAD-dependent decarboxylation of malate in the presence of a divalent cation (*e.g.*, Mg<sup>2+</sup>). NAD-ME is reported to be ineffective in the decarboxylation of OAA (Artus and Edwards, *FEBS Lett.* 182: 225-233 (1985), the entirety of which is herein incorporated by reference). NAD-ME is reported to comprise two subunits (alpha and beta) which differ in molecular weights (58 and 62 kDa, respectively).

In C<sub>4</sub> plants of the PEP carboxykinase (EC 4.1.1.49) type, aspartate is converted into OAA in bundle sheath cells and ketoacid is decarboxylated by cytoplasmic PEP carboxykinase.



PEP carboxykinase is reported to have a requirement for  $Mn^{2+}$  and a preference for ATP (Ashton *et al.*, In: *Methods in Plant Biochemistry*, Lea, ed., Academic Press, New York, p.39 (1990)).

The native enzyme is reported to be a homohexamer with a molecular weight of 380 kDa (subunit molecular weight of 64 kDa). PEP carboxykinase enzyme is reported to be inhibited by the metabolites 3PGA, fructose-6-phosphate, fructose 1,6 biphosphate and DHAP.

In all three subtypes of C4 plants, regeneration of PEP from pyruvate takes place in mesophyll chloroplasts by the reaction catalyzed by pyruvate Pi dikinase (PPDKase (EC 2.7.9.1)). This is a regulatory step in the C4 pathway (Hatch, *Biochim. Biophys. Acta* 895: 81-106 (1987); Ashton *et al.*, In: *Methods in Plant Biochemistry*, Lea, ed., Academic Press, New York, p.39 (1990)). PPDKase is a homotetrameric protein with a molecular weight of about 390 kDa (Ashton *et al.*, In: *Methods in Plant Biochemistry*, Lea, ed., Academic Press, New York, p.39 (1990)). PPDKase is reported to be inactivated by cold temperatures and the absence of  $Mg^{2+}$  and is activated in the light period and inactivated in the dark period ((Ashton *et al.*, In: *Methods in Plant Biochemistry*, Lea, ed., Academic Press, New York, p.39 (1990)). Activation by light of PPDKase is a result of dephosphorylation and the switch to inactive dark form involves phosphorylation.

Pyrophosphatase (inorganic pyrophosphatase (EC 3.6.1.1)) promotes the reaction catalyzed by the enzyme pyruvate Pi dikinase in the direction of PEP synthesis through hydrolysis of PPi (Jiang *et al.*, *Arch. Biochem. Biophys.* 346: 105-112 (1997); Mitchell *et al.*, *Can. J. Microbiol.* 43: 734-743 (1997), both of which are herein incorporated by reference in their entirety). Pyrophosphatase has been isolated from potato (du Jardin *et al.*, *Plant Physiol.* 109:853-860 (1995), herein incorporated by reference in its entirety) and *Arabidopsis* (Kieber and Signer, *Plant Mol. Biol.* 16: 345-348 (1991), herein incorporated by reference in its entirety).

Ribose-5-phosphate kinase (EC 2.7.1.19) is reported to be found in photosynthetic organisms possessing the C-4 pathway. This homodimeric enzyme has a subunit molecular weight of 39.2 kDa (Roeslier and Ogren, *Nucleic Acid Res.* 16: 7192 (1988); Milanez and Mural, *Gene* 66:55-63 (1988), both of which are herein incorporated by reference in their entirety). The N-terminal region seems to be involved in the regulation of catalytic activity. Cys<sup>16</sup> may form a part of the ATP-binding region. Lys<sup>68</sup> has also been implicated in ATP binding (Miziorko *et al.*, *J. Biol. Chem.* 265: 3642-3647 (1990), the entirety of which is herein incorporated by reference).

## VI. EXPRESSED SEQUENCE TAG NUCLEIC ACID MOLECULES

Expressed sequence tags, or ESTs are randomly sequenced members of a cDNA library (or complementary DNA)(McCombie *et al.*, *Nature Genetics* 1:124-130 (1992); Kurata *et al.*, *Nature Genetics* 8:365-372 (1994); Okubo *et al.*, *Nature Genetics* 2:173-179 (1992), all of which references are incorporated herein in their entirety). The randomly selected clones comprise insets that can represent a copy of up to the full length of a mRNA transcript.

Using conventional methodologies, cDNA libraries can be constructed from the mRNA (messenger RNA) of a given tissue or organism using poly dT primers and reverse transcriptase (Efstratiadis *et al.*, *Cell* 7:279-3680 (1976), the entirety of which is herein incorporated by reference; Higuchi *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 73:3146-3150 (1976), the entirety of which is herein incorporated by reference; Maniatis *et al.*, *Cell* 8:163-182 (1976) the entirety of which is herein incorporated by reference; Land *et al.*, *Nucleic Acids Res.* 9:2251-2266 (1981), the entirety of which is herein incorporated by reference; Okayama *et al.*, *Mol. Cell. Biol.* 2:161-170 (1982), the entirety of which is herein incorporated by reference; Gubler *et al.*, *Gene* 25:263-269 (1983), the entirety of which is herein incorporated by reference).

Several methods may be employed to obtain full-length cDNA constructs. For example, terminal transferase can be used to add homopolymeric tails of dC residues to the free 3' hydroxyl groups (Land *et al.*, *Nucleic Acids Res.* 9:2251-2266 (1981), the entirety of which is herein incorporated by reference). This tail can then be hybridized by a poly dG oligo which can act as a primer for the synthesis of full length second strand cDNA. Okayama and Berg, *Mol. Cell. Biol.* 2:161-170 (1982), the entirety of which is herein incorporated by reference, report a method for obtaining full length cDNA constructs. This method has been simplified by using synthetic primer-adapters that have both homopolymeric tails for priming the synthesis of the first and second strands and restriction sites for cloning into plasmids (Coleclough *et al.*, *Gene* 34:305-314 (1985), the entirety of which is herein incorporated by reference) and bacteriophage vectors (Krawinkel *et al.*, *Nucleic Acids Res.* 14:1913 (1986), the entirety of which is herein incorporated by reference; Han *et al.*, *Nucleic Acids Res.* 15:6304 (1987), the entirety of which is herein incorporated by reference).

These strategies have been coupled with additional strategies for isolating rare mRNA populations. For example, a typical mammalian cell contains between 10,000 and 30,000 different mRNA sequences (Davidson, *Gene Activity in Early Development*, 2nd ed., Academic Press, New York (1976), the entirety of which is herein incorporated by reference). The number of clones required to achieve a given probability that a low-abundance mRNA will be present in a cDNA library is  $N = (\ln(1-P))/(\ln(1-1/n))$  where N is the number of clones required, P is the probability desired and 1/n is the fractional proportion of the total mRNA that is represented by a single rare mRNA (Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, 2nd ed., Cold Spring Harbor Laboratory Press (1989), the entirety of which is herein incorporated by reference).

A method to enrich preparations of mRNA for sequences of interest is to fractionate by size. One such method is to fractionate by electrophoresis through an agarose gel (Pennica *et al.*, *Nature* 301:214-221 (1983), the entirety of which is herein incorporated by reference). Another such method employs sucrose gradient centrifugation in the presence of an agent, such as methylmercuric hydroxide, that denatures secondary structure in RNA (Schweinfest *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 79:4997-5000 (1982), the entirety of which is herein incorporated by reference).

A frequently adopted method is to construct equalized or normalized cDNA libraries (Ko, *Nucleic Acids Res.* 18:5705-5711 (1990), the entirety of which is herein incorporated by reference; Patanjali *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 88:1943-1947 (1991), the entirety of which is herein incorporated by reference). Typically, the cDNA population is normalized by subtractive hybridization (Schmid *et al.*, *J. Neurochem.* 48:307-312 (1987), the entirety of which is herein incorporated by reference; Fagnoli *et al.*, *Anal. Biochem.* 187:364-373 (1990), the entirety of which is herein incorporated by reference; Travis *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 85:1696-1700 (1988), the entirety of which is herein incorporated by reference; Kato, *Eur. J. Neurosci.* 2:704-711 (1990); and Schweinfest *et al.*, *Genet. Anal. Tech. Appl.* 7:64-70 (1990), the entirety of which is herein incorporated by reference). Subtraction represents another method for reducing the population of certain sequences in the cDNA library (Swaroop *et al.*, *Nucleic Acids Res.* 19:1954 (1991), the entirety of which is herein incorporated by reference).

ESTs can be sequenced by a number of methods. Two basic methods may be used for DNA sequencing, the chain termination method of Sanger *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 74:5463-5467 (1977), the entirety of which is herein incorporated by reference and the chemical degradation method of Maxam and Gilbert, *Proc. Nat. Acad. Sci. (U.S.A.)* 74:560-564 (1977),

the entirety of which is herein incorporated by reference. Automation and advances in technology such as the replacement of radioisotopes with fluorescence-based sequencing have reduced the effort required to sequence DNA (Craxton, *Methods* 2:20-26 (1991), the entirety of which is herein incorporated by reference; Ju *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 92:4347-4351 (1995), the entirety of which is herein incorporated by reference; Tabor and Richardson, *Proc. Natl. Acad. Sci. (U.S.A.)* 92:6339-6343 (1995), the entirety of which is herein incorporated by reference). Automated sequencers are available from, for example, Pharmacia Biotech, Inc., Piscataway, New Jersey (Pharmacia ALF), LI-COR, Inc., Lincoln, Nebraska (LI-COR 4,000) and Millipore, Bedford, Massachusetts (Millipore BaseStation).

In addition, advances in capillary gel electrophoresis have also reduced the effort required to sequence DNA and such advances provide a rapid high resolution approach for sequencing DNA samples (Swerdlow and Gesteland, *Nucleic Acids Res.* 18:1415-1419 (1990); Smith, *Nature* 349:812-813 (1991); Luckey *et al.*, *Methods Enzymol.* 218:154-172 (1993); Lu *et al.*, *J. Chromatog. A.* 680:497-501 (1994); Carson *et al.*, *Anal. Chem.* 65:3219-3226 (1993); Huang *et al.*, *Anal. Chem.* 64:2149-2154 (1992); Kheterpal *et al.*, *Electrophoresis* 17:1852-1859 (1996); Quesada and Zhang, *Electrophoresis* 17:1841-1851 (1996); Baba, *Yakugaku Zasshi* 117:265-281 (1997), all of which are herein incorporated by reference in their entirety).

ESTs longer than 150 nucleotides have been found to be useful for similarity searches and mapping (Adams *et al.*, *Science* 252:1651-1656 (1991), herein incorporated by reference). ESTs, which can represent copies of up to the full length transcript, may be partially or completely sequenced. Between 150-450 nucleotides of sequence information is usually generated as this is the length of sequence information that is routinely and reliably produced using single run sequence data. Typically, only single run sequence data is obtained from the

cDNA library (Adams *et al.*, *Science* 252:1651-1656 (1991). Automated single run sequencing typically results in an approximately 2-3% error or base ambiguity rate (Boguski *et al.*, *Nature Genetics* 4:332-333 (1993), the entirety of which is herein incorporated by reference).

EST databases have been constructed or partially constructed from, for example, *C. elegans* (McCombie *et al.*, *Nature Genetics* 1:124-131 (1992)), human liver cell line HepG2 (Okubo *et al.*, *Nature Genetics* 2:173-179 (1992)), human brain RNA (Adams *et al.*, *Science* 252:1651-1656 (1991); Adams *et al.*, *Nature* 355:632-635 (1992)), *Arabidopsis*, (Newman *et al.*, *Plant Physiol.* 106:1241-1255 (1994)); and rice (Kurata *et al.*, *Nature Genetics* 8:365-372 (1994)).

## VII. SEQUENCE COMPARISONS

A characteristic feature of a DNA sequence is that it can be compared with other DNA sequences. Sequence comparisons can be undertaken by determining the similarity of the test or query sequence with sequences in publicly available or proprietary databases ("similarity analysis") or by searching for certain motifs ("intrinsic sequence analysis")(e.g. *cis* elements)(Coulson, *Trends in Biotechnology* 12:76-80 (1994), the entirety of which is herein incorporated by reference); Birren *et al.*, *Genome Analysis 1*: Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York 543-559 (1997), the entirety of which is herein incorporated by reference).

Similarity analysis includes database search and alignment. Examples of public databases include the DNA Database of Japan (DDBJ)(<http://www.ddbj.nig.ac.jp/>); Genebank (<http://www.ncbi.nlm.nih.gov/Web/Search/Index.html>); and the European Molecular Biology Laboratory Nucleic Acid Sequence Database (EMBL) ([http://www.ebi.ac.uk/ebi\\_docs/embl\\_db/embl-db.html](http://www.ebi.ac.uk/ebi_docs/embl_db/embl-db.html)). Other appropriate databases include

dbEST (<http://www.ncbi.nlm.nih.gov/dbEST/index.html>), SwissProt ([http://www.ebi.ac.uk/ebi\\_docs/swisprot\\_db/swisshome.html](http://www.ebi.ac.uk/ebi_docs/swisprot_db/swisshome.html)), PIR (<http://www-nbrt.georgetown.edu/pir/>) and The Institute for Genome Research (<http://www.tigr.org/tdb/tdb.html>)

A number of different search algorithms have been developed, one example of which are the suite of programs referred to as BLAST programs. There are five implementations of BLAST, three designed for nucleotide sequences queries (BLASTN, BLASTX and TBLASTX) and two designed for protein sequence queries (BLASTP and TBLASTN) (Coulson, *Trends in Biotechnology* 12:76-80 (1994); Birren *et al.*, *Genome Analysis 1*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York 543-559 (1997)).

BLASTN takes a nucleotide sequence (the query sequence) and its reverse complement and searches them against a nucleotide sequence database. BLASTN was designed for speed, not maximum sensitivity and may not find distantly related coding sequences. BLASTX takes a nucleotide sequence, translates it in three forward reading frames and three reverse complement reading frames and then compares the six translations against a protein sequence database. BLASTX is useful for sensitive analysis of preliminary (single-pass) sequence data and is tolerant of sequencing errors (Gish and States, *Nature Genetics* 3:266-272 (1993), the entirety of which is herein incorporated by reference). BLASTN and BLASTX may be used in concert for analyzing EST data (Coulson, *Trends in Biotechnology* 12:76-80 (1994); Birren *et al.*, *Genome Analysis 1*:543-559 (1997)).

Given a coding nucleotide sequence and the protein it encodes, it is often preferable to use the protein as the query sequence to search a database because of the greatly increased sensitivity to detect more subtle relationships. This is due to the larger alphabet of proteins (20

amino acids) compared with the alphabet of nucleic acid sequences (4 bases), where it is far easier to obtain a match by chance. In addition, with nucleotide alignments, only a match (positive score) or a mismatch (negative score) is obtained, but with proteins, the presence of conservative amino acid substitutions can be taken into account. Here, a mismatch may yield a positive score if the non-identical residue has physical/chemical properties similar to the one it replaced. Various scoring matrices are used to supply the substitution scores of all possible amino acid pairs. A general purpose scoring system is the BLOSUM62 matrix (Henikoff and Henikoff, *Proteins* 17:49-61 (1993), the entirety of which is herein incorporated by reference), which is currently the default choice for BLAST programs. BLOSUM62 is tailored for alignments of moderately diverged sequences and thus may not yield the best results under all conditions. Altschul, *J. Mol. Biol.* 36:290-300 (1993), the entirety of which is herein incorporated by reference, describes a combination of three matrices to cover all contingencies. This may improve sensitivity, but at the expense of slower searches. In practice, a single BLOSUM62 matrix is often used but others (PAM40 and PAM250) may be attempted when additional analysis is necessary. Low PAM matrices are directed at detecting very strong but localized sequence similarities, whereas high PAM matrices are directed at detecting long but weak alignments between very distantly related sequences.

Homologues in other organisms are available that can be used for comparative sequence analysis. Multiple alignments are performed to study similarities and differences in a group of related sequences. CLUSTAL W is a multiple sequence alignment package that performs progressive multiple sequence alignments based on the method of Feng and Doolittle, *J. Mol. Evol.* 25:351-360 (1987), the entirety of which is herein incorporated by reference. Each pair of sequences is aligned and the distance between each pair is calculated; from this distance matrix, a



guide tree is calculated and all of the sequences are progressively aligned based on this tree. A feature of the program is its sensitivity to the effect of gaps on the alignment; gap penalties are varied to encourage the insertion of gaps in probable loop regions instead of in the middle of structured regions. Users can specify gap penalties, choose between a number of scoring matrices, or supply their own scoring matrix for both pairwise alignments and multiple alignments. CLUSTAL W for UNIX and VMS systems is available at: <ftp.ebi.ac.uk>. Another program is MACAW (Schuler *et al.*, *Proteins Struct. Func. Genet.* 9:180-190 (1991), the entirety of which is herein incorporated by reference, for which both Macintosh and Microsoft Windows versions are available. MACAW uses a graphical interface, provides a choice of several alignment algorithms and is available by anonymous ftp at: <ncbi.nlm.nih.gov> (directory/pub/macaw).

Sequence motifs are derived from multiple alignments and can be used to examine individual sequences or an entire database for subtle patterns. With motifs, it is sometimes possible to detect distant relationships that may not be demonstrable based on comparisons of primary sequences alone. Currently, the largest collection of sequence motifs in the world is PROSITE (Bairoch and Bucher, *Nucleic Acid Research* 22:3583-3589 (1994), the entirety of which is herein incorporated by reference). PROSITE may be accessed via either the ExPASy server on the World Wide Web or anonymous ftp site. Many commercial sequence analysis packages also provide search programs that use PROSITE data.

A resource for searching protein motifs is the BLOCKS E-mail server developed by Henikoff, *Trends Biochem Sci.* 18:267-268 (1993), the entirety of which is herein incorporated by reference; Henikoff and Henikoff, *Nucleic Acid Research* 19:6565-6572 (1991), the entirety of which is herein incorporated by reference; Henikoff and Henikoff, *Proteins* 17:49-61 (1993).

BLOCKS searches a protein or nucleotide sequence against a database of protein motifs or “blocks.” Blocks are defined as short, ungapped multiple alignments that represent highly conserved protein patterns. The blocks themselves are derived from entries in PROSITE as well as other sources. Either a protein query or a nucleotide query can be submitted to the BLOCKS server; if a nucleotide sequence is submitted, the sequence is translated in all six reading frames and motifs are sought for these conceptual translations. Once the search is completed, the server will return a ranked list of significant matches, along with an alignment of the query sequence to the matched BLOCKS entries.

Conserved protein domains can be represented by two-dimensional matrices, which measure either the frequency or probability of the occurrences of each amino acid residue and deletions or insertions in each position of the domain. This type of model, when used to search against protein databases, is sensitive and usually yields more accurate results than simple motif searches. Two popular implementations of this approach are profile searches such as GCG program ProfileSearch and Hidden Markov Models (HMMs)(Krough *et al.*, *J. Mol. Biol.* 235:1501-1531, (1994); Eddy, *Current Opinion in Structural Biology* 6:361-365, (1996), both of which are herein incorporated by reference in their entirety). In both cases, a large number of common protein domains have been converted into profiles, as present in the PROSITE library, or HMM models, as in the Pfam protein domain library (Sonnhammer *et al.*, *Proteins* 28:405-420 (1997), the entirety of which is herein incorporated by reference). Pfam contains more than 500 HMM models for enzymes, carbon assimilation pathway enzymes, signal transduction molecules and structural proteins. Protein databases can be queried with these profiles or HMM models, which will identify proteins containing the domain of interest. For example, HMMSW or

HMMFS, two programs in a public domain package called HMMER (Sonnhammer *et al.*, *Proteins* 28:405-420 (1997)) can be used.

PROSITE and BLOCKS represent collected families of protein motifs. Thus, searching these databases entails submitting a single sequence to determine whether or not that sequence is similar to the members of an established family. Programs working in the opposite direction compare a collection of sequences with individual entries in the protein databases. An example of such a program is the Motif Search Tool, or MoST (Tatusov *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 91:12091-12095 (1994), the entirety of which is herein incorporated by reference). On the basis of an aligned set of input sequences, a weight matrix is calculated by using one of four methods (selected by the user). A weight matrix is simply a representation, position by position of how likely a particular amino acid will appear. The calculated weight matrix is then used to search the databases. To increase sensitivity, newly found sequences are added to the original data set, the weight matrix is recalculated and the search is performed again. This procedure continues until no new sequences are found.

### **SUMMARY OF THE INVENTION**

The present invention provides a substantially purified nucleic acid molecule that encodes a maize or soybean carbon assimilation pathway enzyme or fragment thereof, wherein the maize or soybean carbon assimilation pathway enzyme is selected from the group consisting of: (a) ribulose-bisphosphate carboxylase; (b) phosphoglycerate kinase; (c) glyceraldehyde 3-phosphate dehydrogenase; (d) putative glyceraldehyde 3-phosphate dehydrogenase; (e) triose phosphate isomerase; (f) aldolase; (g) fructose-1,6-bisphosphatase; (h) transketolase; (i) putative transketolase; (j) sedoheptulose-1,7-bisphosphatase; (k) D-ribulose-5-phosphate-3-epimerase; (l) ribose-5-phosphate isomerase; (m) putative ribose-5-phosphate isomerase; (n) ribose-5-

phosphate kinase; (o) phosphoenolpyruvate carboxylase; (p) NADP-dependent malate dehydrogenase; (q) aspartate aminotransferase; (r) putative aspartate aminotransferase; (s) alanine aminotransferase; (t) NADP-dependent malic enzyme; (u) NAD-dependent malic enzyme; (v) PEP carboxykinase; (w) putative PEP carboxykinase; (x) pyruvate, phosphate dikinase; and (y) pyrophosphatase.

The present invention also provides a substantially purified nucleic acid molecule that encodes a plant carbon assimilation pathway enzyme or fragment thereof, wherein the nucleic acid molecule is selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase or fragment thereof, a nucleic acid molecule that encodes a maize or

soybean ribose-5-phosphate kinase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase or fragment thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase or fragment thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase or fragment thereof.

The present invention also provides a substantially purified maize or soybean carbon assimilation pathway enzyme or fragment thereof, wherein the maize or soybean carbon assimilation pathway enzyme is selected from the group consisting of (a) ribulose-bisphosphate carboxylase or fragment thereof; (b) phosphoglycerate kinase; (c) glyceraldehyde 3-phosphate dehydrogenase; (d) putative glyceraldehyde 3-phosphate dehydrogenase; (e) triose phosphate isomerase; (f) aldolase; (g) fructose-1,6-bisphosphatase; (h) transketolase; (i) putative transketolase; (j) sedoheptulose-1,7-bisphosphatase; (k) D-ribulose-5-phosphate-3-epimerase; (l) ribose-5-phosphate isomerase; (m) putative ribose-5-phosphate isomerase; (n) ribose-5-phosphate kinase; (o) phosphoenolpyruvate carboxylase; (p) NADP-dependent malate dehydrogenase; (q) aspartate aminotransferase; (r) putative aspartate aminotransferase; (s)

alanine aminotransferase; (t) NADP-dependent malic enzyme; (u) NAD-dependent malic enzyme; (v) PEP carboxykinase; (w) putative PEP carboxykinase; (x) pyruvate, phosphate dikinase; and (y) pyrophosphatase.

The present invention also provides a substantially purified maize or soybean carbon assimilation pathway enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 1 through SEQ ID NO: 7341.

The present invention also provides a substantially purified maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 1 through SEQ ID NO: 281 and SEQ ID NO: 282 through SEQ ID NO: 847.

The present invention also provides a substantially purified maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 281 and SEQ ID NO: 282 through SEQ ID NO: 847.

The present invention also provides a substantially purified maize or soybean phosphoglycerate kinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 848 through SEQ ID NO: 1090 and SEQ ID NO: 1091 through SEQ ID NO: 1307.

The present invention also provides a substantially purified maize or soybean phosphoglycerate kinase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 848 through SEQ ID NO: 1090 and SEQ ID NO: 1091 through SEQ ID NO: 1307.

The present invention also provides a substantially purified maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 1308 through SEQ ID NO: 2383 and SEQ ID NO: 2397 through SEQ ID NO: 3540.

The present invention also provides a substantially purified maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a nucleic acid sequence consisting of SEQ ID NO: 1308 through SEQ ID NO: 2383 and SEQ ID NO: 2397 through SEQ ID NO: 3540.

The present invention also provides a substantially purified putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 2384 through SEQ ID NO: 2396.

The present invention also provides a substantially purified putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a nucleic acid sequence consisting of SEQ ID NO: 2384 through SEQ ID NO: 2396.

The present invention also provides a substantially purified maize or soybean triose phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which

specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 3541 through SEQ ID NO: 3746 and SEQ ID NO: 3747 through SEQ ID NO: 3918.

The present invention also provides a substantially purified maize or soybean triose phosphate isomerase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 3541 through SEQ ID NO: 3746 and SEQ ID NO: 3747 through SEQ ID NO: 3918.

The present invention also provides a substantially purified maize or soybean aldolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 3919 through SEQ ID NO: 3963 and SEQ ID NO: 3964 through SEQ ID NO: 4370.

The present invention also provides a substantially purified maize or soybean aldolase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 3919 through SEQ ID NO: 3963 and SEQ ID NO: 3964 through SEQ ID NO: 4370.

The present invention also provides a substantially purified maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4371 through SEQ ID NO: 4421 and SEQ ID NO: 4422 through SEQ ID NO: 4475.

The present invention also provides a substantially purified soybean fructose-1,6-bisphosphatase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the



group consisting of SEQ ID NO: 4371 through SEQ ID NO: 4421 and SEQ ID NO: 4422 through SEQ ID NO: 4475.

The present invention also provides a substantially purified maize or soybean transketolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4476 through SEQ ID NO: 4513 and SEQ ID NO: 4525 through SEQ ID NO: 4605.

The present invention also provides a substantially purified maize or soybean transketolase or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4476 through SEQ ID NO: 4513 and SEQ ID NO: 4525 through SEQ ID NO: 4605.

The present invention also provides a substantially purified putative maize or soybean transketolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4514 through SEQ ID NO: 4524 and SEQ ID NO: 4606 through SEQ ID NO: 4612.

The present invention also provides a substantially purified putative maize or soybean transketolase or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4514 through SEQ ID NO: 4524 and SEQ ID NO: 4606 through SEQ ID NO: 4612.

The present invention also provides a substantially purified maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic

acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4613 through SEQ ID NO: 4614 and SEQ ID NO: 4615 through SEQ ID NO: 4677.

The present invention also provides a substantially purified maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4613 through SEQ ID NO: 4614 and SEQ ID NO: 4615 through SEQ ID NO: 4677.

The present invention also provides a substantially purified maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4678 through SEQ ID NO: 4723 and SEQ ID NO: 4724 through SEQ ID NO 4762.

The present invention also provides a substantially purified maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4678 through SEQ ID NO: 4723 and SEQ ID NO: 4724 through SEQ ID NO 4762.

The present invention also provides a substantially purified maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 4763 through SEQ ID NO: 4769 and SEQ ID NO: 4772 through SEQ ID NO: 4776.

The present invention also provides a substantially purified maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a nucleic acid sequence consisting

of SEQ ID NO: 4763 through SEQ ID NO: 4769 and SEQ ID NO: 4772 through SEQ ID NO: 4776.

The present invention also provides a substantially purified putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 4770 through SEQ ID NO: 4771 and SEQ ID NO: 4777 through SEQ ID NO: 4781.

The present invention also provides a substantially purified putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a nucleic acid sequence consisting of SEQ ID NO: 4770 through SEQ ID NO: 4771 and SEQ ID NO: 4777 through SEQ ID NO: 4781.

The present invention also provides a substantially purified maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4782 through SEQ ID NO: 4832 and SEQ ID NO: 4833 through SEQ ID NO: 4908.

The present invention also provides a substantially purified maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4782 through SEQ ID NO: 4832 and SEQ ID NO: 4833 through SEQ ID NO: 4908.

The present invention also provides a substantially purified maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic

acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4909 through SEQ ID NO: 5282 and SEQ ID NO: 5283 through SEQ ID NO: 5371.

The present invention also provides a substantially purified maize or soybean phosphoenolpyruvate enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 4909 through SEQ ID NO: 5282 and SEQ ID NO: 5283 through SEQ ID NO: 5371.

The present invention also provides a substantially purified maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5372 through SEQ ID NO: 5419 and SEQ ID NO: 5420 through SEQ ID NO: 5423.

The present invention also provides a substantially purified soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 5372 through SEQ ID NO: 5419 and SEQ ID NO: 5420 through SEQ ID NO: 5423.

The present invention also provides a substantially purified maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5424 through SEQ ID NO: 5596 and SEQ ID NO: 5601 through SEQ ID NO: 5719.

The present invention also provides a substantially purified maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 5424 through SEQ ID NO: 5596 and SEQ ID NO: 5601 through SEQ ID NO: 5719.

The present invention also provides a substantially purified putative maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5597 through SEQ ID NO: 5600 and SEQ ID NO: 5720 through SEQ ID NO: 5727.

The present invention also provides a substantially purified putative maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 5597 through SEQ ID NO: 5600 and SEQ ID NO: 5720 through SEQ ID NO: 5727.

The present invention also provides a substantially purified maize or soybean alanine aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5728 through SEQ ID NO: 5888 and SEQ ID NO: 5889 through SEQ ID NO: 6004.

The present invention also provides a substantially purified maize or soybean alanine aminotransferase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 5728 through SEQ ID NO: 5888 and SEQ ID NO: 5889 through SEQ ID NO: 6004.

The present invention also provides a substantially purified maize or soybean NADP-dependent malic enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6005 through SEQ ID NO: 6223 and SEQ ID NO: 6224 through SEQ ID NO: 6287.

The present invention also provides a substantially purified maize or soybean NADP-dependent malic enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 6005 through SEQ ID NO: 6223 and SEQ ID NO: 6224 through SEQ ID NO: 6287.

The present invention also provides a substantially purified maize or soybean NAD-dependent malic enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 6022 through SEQ ID NO: 6023, SEQ ID NO: 6288 through SEQ ID NO: 6290 and SEQ ID NO: 6291 through SEQ ID NO: 6293.

The present invention also provides a substantially purified maize or soybean NAD-dependent malic enzyme or fragment thereof encoded by a nucleic acid sequence consisting of SEQ ID NO: 6022 through SEQ ID NO: 6023, SEQ ID NO: 6288 through SEQ ID NO: 6290 and SEQ ID NO: 6291 through SEQ ID NO: 6293.

The present invention also provides a substantially purified maize or soybean PEP carboxykinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule

having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6294 through SEQ ID NO: 6353 and SEQ ID NO: 6354 through SEQ ID NO: 6387.

The present invention also provides a substantially purified maize or soybean PEP carboxykinase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 6294 through SEQ ID NO: 6353 and SEQ ID NO: 6354 through SEQ ID NO: 6387.

The present invention also provides a substantially purified putative soybean PEP carboxykinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 6388.

The present invention also provides a substantially purified putative soybean PEP carboxykinase enzyme or fragment thereof encoded by a nucleic acid sequence consisting of SEQ ID NO: 6388.

The present invention also provides a substantially purified maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6389 through SEQ ID NO: 6847 and SEQ ID NO: 6848 through SEQ ID NO: 6850.

The present invention also provides a substantially purified maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 6389 through SEQ ID NO: 6847 and SEQ ID NO: 6848 through SEQ ID NO: 6850.

The present invention also provides a substantially purified maize or soybean pyrophosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6851 through SEQ ID NO: 7154 and SEQ ID NO: 7155 through SEQ ID NO: 7341.

The present invention also provides a substantially purified soybean pyrophosphatase enzyme or fragment thereof encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 6851 through SEQ ID NO: 7154 and SEQ ID NO: 7155 through SEQ ID NO: 7341.

The present invention also provides a purified antibody or fragment thereof which is capable of specifically binding to a maize or soybean carbon assimilation pathway enzyme or fragment thereof, wherein the maize or soybean carbon assimilation pathway enzyme or fragment thereof is encoded by a nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 1 through SEQ ID NO: 281 and SEQ ID NO: 282 through SEQ ID NO: 847.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean phosphoglycerate kinase enzyme or fragment thereof encoded by a first nucleic acid molecule



which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 848 through SEQ ID NO: 1090 and SEQ ID NO: 1091 through SEQ ID NO: 1307.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule consisting of a complement of a nucleic acid sequence having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1308 through SEQ ID NO: 2383 and SEQ ID NO: 2397 through SEQ ID NO: 3540

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule consisting of a complement of a nucleic acid sequence having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 2384 through SEQ ID NO: 2396.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean triose phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 3541 through SEQ ID NO: 3746 and SEQ ID NO: 3747 through SEQ ID NO: 3918.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean aldolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 3919 through SEQ ID NO: 3963 and SEQ ID NO: 3964 through SEQ ID NO: 4370.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4371 through SEQ ID NO: 4421 and SEQ ID NO: 4422 through SEQ ID NO: 4475.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean transketolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4476 through SEQ ID NO: 4513 and SEQ ID NO: 4525 through SEQ ID NO: 4605.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a putative maize or soybean transketolase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule

having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4514 through SEQ ID NO: 4524 and SEQ ID NO: 4606 through SEQ ID NO: 4612.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4613 through SEQ ID NO: 4614 and SEQ ID NO: 4615 through SEQ ID NO: 4677.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4678 through SEQ ID NO: 4723 and SEQ ID NO: 4724 through SEQ ID NO: 4762.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4763 through SEQ ID NO: 4769 and SEQ ID NO: 4772 through SEQ ID NO: 4776.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4770 through SEQ ID NO: 4771 and SEQ ID NO: 4777 through SEQ ID NO: 4781.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4782 through SEQ ID NO: 4832 and SEQ ID NO: 4833 through SEQ ID NO: 4908.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 4909 through SEQ ID NO: 5282 and SEQ ID NO: 5283 through SEQ ID NO: 5371.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof encoded by a first nucleic acid

molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5372 through SEQ ID NO: 5419 and SEQ ID NO: 5420 through SEQ ID NO: 5423.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5424 through SEQ ID NO: 5596 and SEQ ID NO: 5601 through SEQ ID NO: 5719.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5597 through SEQ ID NO: 5600 and SEQ ID NO: 5720 through SEQ ID NO: 5727.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean alanine aminotransferase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 5728 through SEQ ID NO: 5888 and SEQ ID NO: 5889 through SEQ ID NO: 6004.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean NADP-dependent malic enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule consisting of a complement of a nucleic acid sequence having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 6005 through SEQ ID NO: 6223 and SEQ ID NO: 6224 through SEQ ID NO: 6287.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean NAD-dependent malic enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6022 through SEQ ID NO: 6023, SEQ ID NO: 6288 through SEQ ID NO: 6290 and SEQ ID NO: 6291 through SEQ ID NO: 6293.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean PEP carboxykinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6294 through SEQ ID NO: 6353 and SEQ ID NO: 6354 through SEQ ID NO: 6387.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a putative soybean PEP carboxykinase enzyme or fragment thereof encoded by a first nucleic acid molecule which

specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence consisting of a complement of SEQ ID NO: 6388.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6389 through SEQ ID NO: 6847 and SEQ ID NO: 6848 through SEQ ID NO: 6850.

The present invention also provides a substantially purified antibody or fragment thereof, the antibody or fragment thereof capable of specifically binding to a maize or soybean pyrophosphatase enzyme or fragment thereof encoded by a first nucleic acid molecule which specifically hybridizes to a second nucleic acid molecule, the second nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a complement of SEQ ID NO: 6851 through SEQ ID NO: 7154 and SEQ ID NO: 7155 through SEQ ID NO: 7341.

The present invention also provides a transformed plant having a nucleic acid molecule which comprises: (A) an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule; (B) a structural nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of (a) a nucleic acid sequence which encodes for a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof; (b) a nucleic acid sequence which encodes for a maize or soybean phosphoglycerate kinase enzyme or fragment thereof; (c) a nucleic acid sequence which encodes for a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof; (d) a nucleic acid sequence which encodes for a putative maize glyceraldehyde 3-phosphate dehydrogenase

enzyme or fragment thereof; (e) a nucleic acid sequence which encodes for a maize or soybean triose phosphate isomerase enzyme or fragment thereof; (f) a nucleic acid sequence which encodes for a maize or soybean aldolase enzyme or fragment thereof; (g) a nucleic acid sequence which encodes for a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof; (h) a nucleic acid sequence which encodes for a maize or soybean transketolase enzyme or fragment thereof; (i) a nucleic acid sequence which encodes for a putative maize or soybean transketolase enzyme or fragment thereof; (j) a nucleic acid sequence which encodes for a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof; (k) a nucleic acid sequence which encodes for a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof; (l) a nucleic acid sequence which encodes for a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof; (m) a nucleic acid sequence which encodes for a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof; (n) a nucleic acid sequence which encodes for a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof; (o) a nucleic acid sequence which encodes for a maize or soybean phosphoenolpyruvate dehydrogenase enzyme or fragment thereof; (p) a nucleic acid sequence which encodes for a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof; (q) a nucleic acid sequence which encodes for a maize or soybean aspartate aminotransferase enzyme or fragment thereof; (r) a nucleic acid sequence which encodes for a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof; (s) a nucleic acid sequence which encodes for a maize or soybean alanine aminotransferase enzyme or fragment thereof; (t) a nucleic acid sequence which encodes for a maize or soybean NADP-dependent malic enzyme or fragment thereof; (u) a nucleic acid sequence which encodes for a maize or soybean NAD-dependent malic enzyme or fragment thereof; (v) a nucleic acid sequence



which encodes for a maize or soybean PEP carboxykinase enzyme or fragment thereof; (w) a nucleic acid sequence which encodes for a putative soybean PEP carboxykinase enzyme or fragment thereof; (x) a nucleic acid sequence which encodes for a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof; and (y) a nucleic acid sequence which encodes for a maize or soybean pyrophosphatase enzyme or fragment thereof; (z) a nucleic acid sequence which is complementary to any of the nucleic acid sequences of (a) through (y); and (C) a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of the mRNA molecule.

The present invention also provides a transformed plant having a nucleic acid molecule which comprises: (A) an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule; which is linked to (B) a structural nucleic acid molecule, wherein the structural nucleic acid molecule encodes a plant carbon assimilation pathway enzyme or fragment thereof, the structural nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof; which is linked to (C) a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of the mRNA molecule.

The present invention also provides a transformed plant having a nucleic acid molecule which comprises: (A) an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule; which is linked to (B) a structural nucleic acid molecule, wherein the structural nucleic acid molecule is selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate

kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or fragments thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or fragments thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or fragments thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragments thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragments thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid

molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof, and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or fragments thereof; which is linked to (C) a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of the mRNA molecule.

The present invention also provides a transformed plant having a nucleic acid molecule which comprises: (A) an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule; which is linked to (B) a transcribed nucleic acid molecule with a transcribed strand and a non-transcribed strand, wherein the transcribed strand is complementary to a nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof; which is linked to (C) a 3' non-translated sequence that functions in plant cells to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of the mRNA molecule.

The present invention also provides a transformed plant having a nucleic acid molecule which comprises: (A) an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule; which is linked to: (B) a transcribed nucleic acid molecule with a transcribed strand and a non-transcribed strand, wherein a transcribed mRNA of the transcribed strand is complementary to an endogenous mRNA molecule having a nucleic acid sequence selected from the group consisting of an endogenous mRNA molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof; an endogenous



encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof; an endogenous mRNA molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof; an endogenous mRNA molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof; an endogenous mRNA molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof; an endogenous mRNA molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof; an endogenous mRNA molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof; and an endogenous mRNA molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof; which is linked to (C) a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of the mRNA molecule.

The present invention also provides a method for determining a level or pattern of a plant carbon assimilation pathway enzyme in a plant cell or plant tissue comprising: (A) incubating, under conditions permitting nucleic acid hybridization, a marker nucleic acid molecule, the marker nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragment of either, with a complementary nucleic acid molecule obtained from the plant cell or plant tissue, wherein nucleic acid hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant cell or plant tissue permits the detection of the plant carbon assimilation pathway enzyme; (B) permitting hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant cell or plant tissue; and (C) detecting the level or pattern of the complementary nucleic acid, wherein

the detection of the complementary nucleic acid is predictive of the level or pattern of the plant carbon assimilation pathway enzyme.

The present invention also provides a method for determining a level or pattern of a plant carbon assimilation pathway enzyme in a plant cell or plant tissue comprising: (A) incubating, under conditions permitting nucleic acid hybridization, a marker nucleic acid molecule, the marker nucleic acid molecule comprising a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement

thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof or fragment of either and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof or fragment of either, with a complementary nucleic acid molecule obtained from the plant cell or plant tissue, wherein nucleic acid hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant cell or plant tissue permits the detection of the plant carbon

assimilation pathway enzyme; (B) permitting hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant cell or plant tissue; and (C) detecting the level or pattern of the complementary nucleic acid, wherein the detection of the complementary nucleic acid is predictive of the level or pattern of the plant carbon assimilation pathway enzyme.

The present invention also provides a method for determining a level or pattern of a plant carbon assimilation pathway enzyme in a plant cell or plant tissue under evaluation which comprises assaying the concentration of a molecule, whose concentration is dependent upon the expression of a gene, the gene specifically hybridizes to a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof, in comparison to the concentration of that molecule present in a reference plant cell or a reference plant tissue with a known level or pattern of the plant carbon assimilation pathway enzyme, wherein the assayed concentration of the molecule is compared to the assayed concentration of the molecule in the reference plant cell or reference plant tissue with the known level or pattern of the plant carbon assimilation pathway enzyme.

The present invention also provides a method for determining a level or pattern of a plant carbon assimilation pathway enzyme in a plant cell or plant tissue under evaluation which comprises assaying the concentration of a molecule, whose concentration is dependent upon the expression of a gene, the gene specifically hybridizes to a nucleic acid molecule selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or



complement thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme enzyme or

complement thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof, in comparison to the concentration of that molecule present in a reference plant cell or a reference plant tissue with a known level or pattern of the plant carbon assimilation pathway enzyme, wherein the assayed concentration of the molecule is compared to the assayed concentration of the molecule in the reference plant cell or the reference plant tissue with the known level or pattern of the plant carbon assimilation pathway enzyme.

The present invention provides a method of determining a mutation in a plant whose presence is predictive of a mutation affecting a level or pattern of a protein comprising the steps: (A) incubating, under conditions permitting nucleic acid hybridization, a marker nucleic acid, the marker nucleic acid selected from the group of marker nucleic acid molecules which specifically hybridize to a nucleic acid molecule having a nucleic acid sequence selected from the group of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragment of either and a complementary nucleic acid molecule obtained from the plant, wherein nucleic acid hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant permits the detection of a polymorphism whose presence is predictive of a mutation affecting the level or pattern of the protein in the plant; (B) permitting hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant; and (C) detecting the presence of the polymorphism, wherein the detection of the polymorphism is predictive of the mutation.

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The present invention also provides a method for determining a mutation in a plant whose presence is predictive of a mutation affecting the level or pattern of a plant carbon assimilation pathway enzyme comprising the steps: (A) incubating, under conditions permitting nucleic acid hybridization, a marker nucleic acid molecule, the marker nucleic acid molecule comprising a nucleic acid molecule that is linked to a gene, the gene specifically hybridizes to a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof and a complementary nucleic acid molecule obtained from the plant, wherein nucleic acid hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant permits the detection of a polymorphism whose presence is predictive of a mutation affecting the level or pattern of the plant carbon assimilation pathway enzyme in the plant; (B) permitting hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant; and (C) detecting the presence of the polymorphism, wherein the detection of the polymorphism is predictive of the mutation.

The present invention also provides a method for determining a mutation in a plant whose presence is predictive of a mutation affecting the level or pattern of a plant carbon assimilation pathway enzyme comprising the steps: (A) incubating, under conditions permitting nucleic acid hybridization, a marker nucleic acid molecule, the marker nucleic acid molecule comprising a nucleic acid molecule that is linked to a gene, the gene specifically hybridizes to a nucleic acid molecule selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate

dehydrogenase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme

or complement thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof, and a complementary nucleic acid molecule obtained from the plant, wherein nucleic acid hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant permits the detection of a polymorphism whose presence is predictive of a mutation affecting the level or pattern of the plant carbon assimilation pathway enzyme in the plant; (B) permitting hybridization between the marker nucleic acid molecule and the complementary nucleic acid molecule obtained from the plant; and (C) detecting the presence of the polymorphism, wherein the detection of the polymorphism is predictive of the mutation.

The present invention also provides a method of producing a plant containing an overexpressed protein comprising: (A) transforming the plant with a functional nucleic acid molecule, wherein the functional nucleic acid molecule comprises a promoter region, wherein the promoter region is linked to a structural region, wherein the structural region has a nucleic acid sequence selected from group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341; wherein the structural region is linked to a 3' non-translated sequence that functions in the plant to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and wherein the functional nucleic acid molecule results in overexpression of the protein; and (B) growing the transformed plant.

The present invention also provides a method of producing a plant containing an overexpressed plant carbon assimilation pathway enzyme comprising: (A) transforming the plant

with a functional nucleic acid molecule, wherein the functional nucleic acid molecule comprises a promoter region, wherein the promoter region is linked to a structural region, wherein the structural region comprises a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof; wherein the structural region is linked to a 3' non-translated sequence that functions in the plant to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and wherein the functional nucleic acid molecule results in overexpression of the plant carbon assimilation pathway enzyme; and (B) growing the transformed plant.

The present invention also provides a method of producing a plant containing an overexpressed plant carbon assimilation pathway enzyme comprising: (A) transforming the plant with a functional nucleic acid molecule, wherein the functional nucleic acid molecule comprises a promoter region, wherein the promoter region is linked to a structural region, wherein the structural region comprises a nucleic acid molecule selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule

that encodes a putative maize or soybean transketolase enzyme or fragment thereof a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof; wherein the structural region is linked to a 3' non-translated sequence that functions in the plant to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and wherein the

functional nucleic acid molecule results in overexpression of the plant carbon assimilation pathway enzyme; and (B) growing the transformed plant.

The present invention also provides a method of producing a plant containing reduced levels of a plant carbon assimilation pathway enzyme comprising: (A) transforming the plant with a functional nucleic acid molecule, wherein the functional nucleic acid molecule comprises a promoter region, wherein the promoter region is linked to a structural region, wherein the structural region comprises a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341; wherein the structural region is linked to a 3' non-translated sequence that functions in the plant to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and wherein the functional nucleic acid molecule results in co-suppression of the plant carbon assimilation pathway enzyme; and (B) growing the transformed plant.

The present invention also provides a method of producing a plant containing reduced levels of a plant carbon assimilation pathway enzyme comprising: (A) transforming the plant with a functional nucleic acid molecule, wherein the functional nucleic acid molecule comprises a promoter region, wherein the promoter region is linked to a structural region, wherein the structural region comprises a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or



soybean triose phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a

maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof wherein the structural region is linked to a 3' non-translated sequence that functions in the plant to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and wherein the functional nucleic acid molecule results in co-suppression of the plant carbon assimilation pathway enzyme; and (B) growing the transformed plant.

The present invention also provides a method for reducing expression of a plant carbon assimilation pathway enzyme in a plant comprising: (A) transforming the plant with a nucleic acid molecule, the nucleic acid molecule having an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule, wherein the exogenous promoter region is linked to a transcribed nucleic acid molecule having a transcribed strand and a non-transcribed strand, wherein the transcribed strand is complementary to a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either and the transcribed strand is complementary to an endogenous mRNA molecule; and wherein the transcribed nucleic acid molecule is linked to a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and (B) growing the transformed plant.

The present invention also provides a method for reducing expression of a plant carbon assimilation pathway enzyme in a plant comprising: (A) transforming the plant with a nucleic acid molecule, the nucleic acid molecule having an exogenous promoter region which functions in a plant cell to cause the production of a mRNA molecule, wherein the exogenous promoter region is linked to a transcribed nucleic acid molecule having a transcribed strand and a non-

transcribed strand, wherein a transcribed mRNA of the transcribed strand is complementary to a nucleic acid molecule selected from the group consisting of an endogenous mRNA molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof an endogenous mRNA molecule that encodes a maize or soybean triose phosphate isomerase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean aldolase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean transketolase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a putative maize or soybean transketolase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, an endogenous

mRNA molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, an endogenous mRNA molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof and an endogenous mRNA molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof, and wherein the transcribed nucleic acid molecule is linked to a 3' non-translated sequence that functions in the plant cell to cause termination of transcription and addition of polyadenylated ribonucleotides to a 3' end of a mRNA molecule; and (B) growing the transformed plant.

The present invention also provides a method of determining an association between a polymorphism and a plant trait comprising: (A) hybridizing a nucleic acid molecule specific for the polymorphism to genetic material of a plant, wherein the nucleic acid molecule has a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragment of either; and (B) calculating the degree of association between the polymorphism and the plant trait.

The present invention also provides a method of determining an association between a polymorphism and a plant trait comprising: (A) hybridizing a nucleic acid molecule specific for

the polymorphism to genetic material of a plant, wherein the nucleic acid molecule is selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or

soybean phosphoenolpyruvate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof or fragment of either and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof or fragment of either; and (B) calculating the degree of association between the polymorphism and the plant trait.

The present invention also provides a method of isolating a nucleic acid that encodes a plant carbon assimilation pathway enzyme or fragment thereof comprising: (A) incubating under conditions permitting nucleic acid hybridization, a first nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragment of either with a complementary second nucleic acid molecule obtained from a plant cell or plant tissue; (B) permitting hybridization between the first

nucleic acid molecule and the second nucleic acid molecule obtained from the plant cell or plant tissue; and (C) isolating the second nucleic acid molecule.

The present invention also provides a method of isolating a nucleic acid molecule that encodes a plant carbon assimilation pathway enzyme or fragment thereof comprising: (A) incubating under conditions permitting nucleic acid hybridization, a first nucleic acid molecule selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement

thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof or fragment of either and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof or fragment of either; with a complementary second nucleic acid molecule obtained from a plant cell or plant tissue; (B) permitting hybridization between the plant carbon assimilation pathway enzyme nucleic acid molecule and



the complementary nucleic acid molecule obtained from the plant cell or plant tissue; and (C) isolating the second nucleic acid molecule.

## **DETAILED DESCRIPTION OF THE INVENTION**

### **Agents of the Present Invention**

#### **Agents**

##### **(a) Nucleic Acid Molecules**

Agents of the present invention include plant nucleic acid molecules and more preferably include maize and soybean nucleic acid molecules and more preferably include nucleic acid molecules of the maize genotypes B73 (Illinois Foundation Seeds, Champaign, Illinois U.S.A.), B73 x Mo17 (Illinois Foundation Seeds, Champaign, Illinois U.S.A.), DK604 (Dekalb Genetics, Dekalb, Illinois U.S.A.), H99 (Illinois Foundation Seeds, Champaign, Illinois U.S.A.), RX601 (Asgrow Seed Company, Des Moines, Iowa), Mo17 (Illinois Foundation Seeds, Champaign, Illinois U.S.A.), and soybean types Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa), C1944 (United States Department of Agriculture (USDA) Soybean Germplasm Collection, Urbana, Illinois U.S.A.), Cristalina (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.), FT108 (Monsoy, Brazil), Hartwig (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.), BW211S Null (Tohoku University, Morioka, Japan), PI507354 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.), Asgrow A4922 (Asgrow Seed Company, Des Moines, Iowa U.S.A.), PI227687 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.), PI229358 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) and Asgrow A3237 (Asgrow Seed Company, Des Moines, Iowa U.S.A.).

A subset of the nucleic acid molecules of the present invention includes nucleic acid molecules that are marker molecules. Another subset of the nucleic acid molecules of the present

invention include nucleic acid molecules that encode a protein or fragment thereof. Another subset of the nucleic acid molecules of the present invention are EST molecules.

Fragment nucleic acid molecules may encode significant portion(s) of, or indeed most of, these nucleic acid molecules. Alternatively, the fragments may comprise smaller oligonucleotides (having from about 15 to about 250 nucleotide residues and more preferably, about 15 to about 30 nucleotide residues).

As used herein, an agent, be it a naturally occurring molecule or otherwise may be "substantially purified," if desired, such that one or more molecules that is or may be present in a naturally occurring preparation containing that molecule will have been removed or will be present at a lower concentration than that at which it would normally be found.

The agents of the present invention will preferably be "biologically active" with respect to either a structural attribute, such as the capacity of a nucleic acid to hybridize to another nucleic acid molecule, or the ability of a protein to be bound by an antibody (or to compete with another molecule for such binding). Alternatively, such an attribute may be catalytic and thus involve the capacity of the agent to mediate a chemical reaction or response.

The agents of the present invention may also be recombinant. As used herein, the term recombinant means any agent (e.g. DNA, peptide etc.), that is, or results, however indirect, from human manipulation of a nucleic acid molecule.

It is understood that the agents of the present invention may be labeled with reagents that facilitate detection of the agent (e.g. fluorescent labels, Prober *et al.*, *Science* 238:336-340 (1987); Albarella *et al.*, EP 144914; chemical labels, Sheldon *et al.*, U.S. Patent No. 4,582,789; Albarella *et al.*, U.S. Patent No. 4,563,417; modified bases, Miyoshi *et al.*, EP 119448, all of which are hereby incorporated by reference in their entirety).

It is further understood, that the present invention provides recombinant bacterial, mammalian, microbial, insect, fungal and plant cells and viral constructs comprising the agents of the present invention. (See, for example, Uses of the Agents of the Invention, Section (a) Plant Constructs and Plant Transformants; Section (b) Fungal Constructs and Fungal Transformants; Section (c) Mammalian Constructs and Transformed Mammalian Cells; Section (d) Insect Constructs and Transformed Insect Cells; and Section (e) Bacterial Constructs and Transformed Bacterial Cells)

Nucleic acid molecules or fragments thereof of the present invention are capable of specifically hybridizing to other nucleic acid molecules under certain circumstances. As used herein, two nucleic acid molecules are said to be capable of specifically hybridizing to one another if the two molecules are capable of forming an anti-parallel, double-stranded nucleic acid structure. A nucleic acid molecule is said to be the "complement" of another nucleic acid molecule if they exhibit complete complementarity. As used herein, molecules are said to exhibit "complete complementarity" when every nucleotide of one of the molecules is complementary to a nucleotide of the other. Two molecules are said to be "minimally complementary" if they can hybridize to one another with sufficient stability to permit them to remain annealed to one another under at least conventional "low-stringency" conditions. Similarly, the molecules are said to be "complementary" if they can hybridize to one another with sufficient stability to permit them to remain annealed to one another under conventional "high-stringency" conditions. Conventional stringency conditions are described by Sambrook *et al.*, *Molecular Cloning*, A Laboratory Manual, 2nd Ed., Cold Spring Harbor Press, Cold Spring Harbor, New York (1989) and by Haymes *et al.*, *Nucleic Acid Hybridization*, A Practical Approach, IRL Press, Washington, DC (1985), the entirety of which is herein incorporated by

reference. Departures from complete complementarity are therefore permissible, as long as such departures do not completely preclude the capacity of the molecules to form a double-stranded structure. Thus, in order for a nucleic acid molecule to serve as a primer or probe it need only be sufficiently complementary in sequence to be able to form a stable double-stranded structure under the particular solvent and salt concentrations employed.

Appropriate stringency conditions which promote DNA hybridization, for example, 6.0 X sodium chloride/sodium citrate (SSC) at about 45°C, followed by a wash of 2.0 X SSC at 50°C, are known to those skilled in the art or can be found in *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1989), 6.3.1-6.3.6. For example, the salt concentration in the wash step can be selected from a low stringency of about 2.0 X SSC at 50°C to a high stringency of about 0.2 X SSC at 50°C. In addition, the temperature in the wash step can be increased from low stringency conditions at room temperature, about 22°C, to high stringency conditions at about 65°C. Both temperature and salt may be varied, or either the temperature or the salt concentration may be held constant while the other variable is changed.

In a preferred embodiment, a nucleic acid of the present invention will specifically hybridize to one or more of the nucleic acid molecules set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof under moderately stringent conditions, for example at about 2.0 X SSC and about 65°C.

In a particularly preferred embodiment, a nucleic acid of the present invention will include those nucleic acid molecules that specifically hybridize to one or more of the nucleic acid molecules set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof under high stringency conditions such as 0.2 X SSC and about 65°C.

In one aspect of the present invention, the nucleic acid molecules of the present invention have one or more of the nucleic acid sequences set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof. In another aspect of the present invention, one or more of the nucleic acid molecules of the present invention share between 100% and 90% sequence identity with one or more of the nucleic acid sequences set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof. In a further aspect of the present invention, one or more of the nucleic acid molecules of the present invention share between 100% and 95% sequence identity with one or more of the nucleic acid sequences set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof. In a more preferred aspect of the present invention, one or more of the nucleic acid molecules of the present invention share between 100% and 98% sequence identity with one or more of the nucleic acid sequences set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof. In an even more preferred aspect of the present invention, one or more of the nucleic acid molecules of the present invention share between 100% and 99% sequence identity with one or more of the sequences set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof.

In a further more preferred aspect of the present invention, one or more of the nucleic acid molecules of the present invention exhibit 100% sequence identity with a nucleic acid molecule present within MONN01, SATMON001, SATMON003 through SATMON014, SATMON016, SATMON017, SATMON019 through SATMON031, SATMON033, SATMON034, SATMON~001, SATMONNN01, SATMONNN04 through SATMONNN06, CMz029 through CMz031, CMz033 through CMz037, CMz039 through CMz042, CMz044 through CMz045, CMz047 through CMz050, SOYMON001 through SOYMON038, Soy51 through

Soy56, Soy58 through Soy62, Soy65 through Soy71, Soy 73 and Soy76 through Soy77  
(Monsanto Company, St. Louis, Missouri U.S.A.).

**(i) Nucleic Acid Molecules Encoding Proteins or Fragments Thereof**

Nucleic acid molecules of the present invention can comprise sequences that encode a carbon assimilation pathway enzyme or fragment thereof. Such carbon assimilation pathway enzymes or fragments thereof include homologues of known carbon assimilation pathway enzymes in other organisms.

In a preferred embodiment of the present invention, a maize or soybean carbon assimilation pathway enzyme or fragment thereof of the present invention is a homologue of another plant carbon assimilation pathway enzyme. In another preferred embodiment of the present invention, a maize or soybean carbon assimilation pathway enzyme or fragment thereof of the present invention is a homologue of a fungal carbon assimilation pathway enzyme. In another preferred embodiment of the present invention, a maize or soybean carbon assimilation pathway enzyme or fragment thereof of the present invention is a homologue of a bacterial carbon assimilation pathway enzyme. In another preferred embodiment of the present invention, a soybean carbon assimilation pathway enzyme or fragment thereof of the present invention is a homologue of a maize carbon assimilation pathway enzyme. In another preferred embodiment of the present invention, a maize carbon assimilation pathway enzyme homologue or fragment thereof of the present invention is a homologue of a soybean carbon assimilation pathway enzyme. In another preferred embodiment of the present invention, a maize or soybean carbon assimilation pathway enzyme homologue or fragment thereof of the present invention is a homologue of an *Arabidopsis thaliana* carbon assimilation pathway enzyme.

In a preferred embodiment of the present invention, the nucleic molecule of the present invention encodes a maize or soybean carbon assimilation pathway enzyme or fragment thereof where a maize or soybean carbon assimilation pathway enzyme exhibits a BLAST probability score of greater than 1E-12, preferably a BLAST probability score of between about 1E-30 and about 1E-12, even more preferably a BLAST probability score of greater than 1E-30 with its homologue.

In another preferred embodiment of the present invention, the nucleic acid molecule encoding a maize or soybean carbon assimilation pathway enzyme or fragment thereof exhibits a % identity with its homologue of between about 25% and about 40%, more preferably of between about 40 and about 70%, even more preferably of between about 70% and about 90% and even more preferably between about 90% and 99%. In another preferred embodiment, of the present invention, a maize or soybean carbon assimilation pathway enzyme or fragments thereof exhibits a % identity with its homologue of 100%.

In a preferred embodiment of the present invention, the nucleic molecule of the present invention encodes a maize or soybean carbon assimilation pathway enzyme or fragment thereof where a maize or soybean carbon assimilation pathway enzyme exhibits a BLAST score of greater than 120, preferably a BLAST score of between about 1450 and about 120, even more preferably a BLAST score of greater than 1450 with its homologue.

Nucleic acid molecules of the present invention also include non-maize, non-soybean homologues. Preferred non-maize, non-soybean homologues are selected from the group consisting of alfalfa, *Arabidopsis*, barley, *Brassica*, broccoli, cabbage, citrus, cotton, garlic, oat, oilseed rape, onion, canola, flax, an ornamental plant, pea, peanut, pepper, potato, rice, rye,

sorghum, strawberry, sugarcane, sugarbeet, tomato, wheat, poplar, pine, fir, eucalyptus, apple, lettuce, lentils, grape, banana, tea, turf grasses, sunflower, oil palm and *Phaseolus*.

In a preferred embodiment, nucleic acid molecules having SEQ ID NO: 1 through SEQ ID NO: 7341 or complements and fragments of either can be utilized to obtain such homologues.

The degeneracy of the genetic code, which allows different nucleic acid sequences to code for the same protein or peptide, is known in the literature. (U.S. Patent No. 4,757,006, the entirety of which is herein incorporated by reference).

In an aspect of the present invention, one or more of the nucleic acid molecules of the present invention differ in nucleic acid sequence from those encoding a maize or soybean carbon assimilation pathway enzyme or fragment thereof in SEQ ID NO: 1 through SEQ ID NO: 7341 due to the degeneracy in the genetic code in that they encode the same carbon assimilation pathway enzyme but differ in nucleic acid sequence.

In another further aspect of the present invention, one or more of the nucleic acid molecules of the present invention differ in nucleic acid sequence from those encoding a maize or soybean carbon assimilation pathway enzyme or fragment thereof in SEQ ID NO: 1 through SEQ ID NO: 7341 due to fact that the different nucleic acid sequence encodes a carbon assimilation pathway enzyme having one or more conservative amino acid residue. Examples of conservative substitutions are set forth in Table 1. It is understood that codons capable of coding for such conservative substitutions are known in the art.



**Table 1**

<u>Original Residue</u>	<u>Conservative Substitutions</u>
Ala	Ser
Arg	Lys
Asn	Gln; His
Asp	Glu
Cys	Ser; Ala
Gln	Asn
Glu	Asp
Gly	Pro
His	Asn; Gln
Ile	Leu; Val
Leu	Ile; Val
Lys	Arg; Gln; Glu
Met	Leu; Ile
Phe	Met; Leu; Tyr
Ser	Thr
Thr	Ser
Trp	Tyr
Tyr	Trp; Phe
Val	Ile; Leu

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In a further aspect of the present invention, one or more of the nucleic acid molecules of the present invention differ in nucleic acid sequence from those encoding a maize or soybean carbon assimilation pathway enzyme or fragment thereof set forth in SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof due to the fact that one or more codons encoding an amino acid has been substituted for a codon that encodes a nonessential substitution of the amino acid originally encoded.

Agents of the present invention include nucleic acid molecules that encode a maize or soybean carbon assimilation pathway enzyme or fragment thereof and particularly substantially purified nucleic acid molecules selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate

isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof.

Non-limiting examples of such nucleic acid molecules of the present invention are nucleic acid molecules comprising: SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof that encode for a plant carbon assimilation pathway enzyme or fragment thereof, SEQ ID NO: 1 through SEQ ID NO: 281 and SEQ ID NO: 282 through SEQ ID NO: 847 or fragment thereof that encode for a ribulose-bisphosphate carboxylase enzyme or fragment thereof, SEQ ID NO: 848 through SEQ ID NO: 1090 and SEQ ID NO: 1091 through SEQ ID NO: 1307 or

fragment thereof that encode for a phosphoglycerate kinase enzyme or fragment thereof, SEQ ID NO: 1308 through SEQ ID NO: 2383 and SEQ ID NO: 2397 through SEQ ID NO: 3450 or fragment thereof that encodes for a glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, SEQ ID NO: 2384 through SEQ ID NO: 2396 or fragment thereof that encodes for a putative glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, SEQ ID NO: 3541 through SEQ ID NO: 3746 and SEQ ID NO: 3747 through SEQ ID NO: 3918 or fragment thereof that encode for a triose phosphate isomerase enzyme or fragment thereof, SEQ ID NO: 3919 through SEQ ID NO: 3963 and SEQ ID NO: 3964 through SEQ ID NO: 4370 or fragment thereof that encode for an aldolase enzyme or fragment thereof, SEQ ID NO: 4371 through SEQ ID NO: 4421 and SEQ ID NO: 4422 through SEQ ID NO: 4475 or fragment thereof that encode for a fructose-1,6-bisphosphatase enzyme or fragment thereof, SEQ ID NO: 4476 through SEQ ID NO: 4513 and SEQ ID NO: 4525 through SEQ ID NO: 4605 or fragment thereof that encode for a transketolase enzyme or fragment thereof, SEQ ID NO: 4514 through SEQ ID NO: 4524 and SEQ ID NO: 4606 through SEQ ID NO: 4612 or fragment thereof that encode for a putative transketolase enzyme or fragment thereof, SEQ ID NO: 4613 through SEQ ID NO: 4614 and SEQ ID NO: 4615 through SEQ ID NO: 4677 or fragment thereof that encode for a sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, SEQ ID NO: 4678 through SEQ ID NO: 4723 and SEQ ID NO: 4724 through SEQ ID NO: 4762 or fragment thereof that encode for a ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, SEQ ID NO: 4763 through SEQ ID NO: 4769 and SEQ ID NO: 4772 through SEQ ID NO: 4776 or fragment thereof that encodes for a D-ribose-5-phosphate isomerase enzyme or fragment thereof, SEQ ID NO: 4770 through SEQ ID NO: 4771 and SEQ ID NO: 4777 through SEQ ID NO: 4781 or fragment thereof that encodes for a putative ribose-5-phosphate isomerase enzyme or fragment

thereof, SEQ ID NO: 4782 through SEQ ID NO: 4832 and SEQ ID NO: 4833 through SEQ ID NO: 4908 or fragment thereof that encode for a ribose-5-phosphate kinase enzyme or fragment thereof, SEQ ID NO: 4909 through SEQ ID NO: 5282 and SEQ ID NO: 5283 through SEQ ID NO: 5371 or fragment thereof that encode for a phosphoenolpyruvate carboxylase enzyme or fragment thereof, SEQ ID NO: 5372 through SEQ ID NO: 5419 and SEQ ID NO: 5420 through SEQ ID NO: 5423 or fragment thereof that encode for a NADP-dependent malate dehydrogenase enzyme or fragment thereof, SEQ ID NO: 5424 through SEQ ID NO: 5596 and SEQ ID NO: 5601 through SEQ ID NO: 5719 or fragment thereof that encode for an aspartate aminotransferase enzyme or fragment thereof, SEQ ID NO: 5597 through SEQ ID NO: 5600 and SEQ ID NO: 5720 through SEQ ID NO: 5727 or fragment thereof that encode for a putative aspartate aminotransferase enzyme or fragment thereof, SEQ ID NO: 5728 through SEQ ID NO: 5888 and SEQ ID NO: 5889 through SEQ ID NO: 6004 or fragment thereof that encode for an alanine aminotransferase enzyme or fragment thereof, SEQ ID NO: 6005 through SEQ ID NO: 6223 and SEQ ID NO: 6224 through SEQ ID NO: 6287 or fragment thereof that encode for a NADP-dependent malic enzyme or fragment thereof, SEQ ID NO: 6022 through SEQ ID NO: 6023, SEQ ID NO: 6288 through SEQ ID NO: 6290 and SEQ ID NO: 6291 through SEQ ID NO: 6293 or fragment thereof that encodes for a NAD-dependent malic enzyme or fragment thereof, SEQ ID NO: 6294 through SEQ ID NO: 6353 and SEQ ID NO: 6354 through SEQ ID NO: 6387 or fragment thereof that encode for a PEP carboxykinase enzyme or fragment thereof, SEQ ID NO: 6388 or fragment thereof that encode for a putative PEP carboxykinase enzyme or fragment thereof, SEQ ID NO: 6389 through SEQ ID NO: 6847 and SEQ ID NO: 6848 through SEQ ID NO: 6850 or fragment thereof that encode for a pyruvate, phosphate dikinase enzyme or fragment thereof, and SEQ ID NO: 6851 through SEQ ID NO: 7154 and SEQ ID NO: 7155

through SEQ ID NO: 7341 or fragment thereof that encode for a pyrophosphatase enzyme or fragment thereof.

A nucleic acid molecule of the present invention can also encode an homologue of a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a putative maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a maize or soybean aldolase enzyme or fragment thereof, a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a maize or soybean transketolase enzyme or fragment thereof, a putative maize or soybean transketolase enzyme or fragment thereof, a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a maize or soybean alanine aminotransferase enzyme or fragment thereof, a maize or soybean NADP-dependent malic enzyme or fragment thereof, a maize or soybean NAD-dependent malic enzyme or fragment thereof, a maize or soybean PEP carboxykinase enzyme or fragment thereof, a putative maize or soybean PEP carboxykinase enzyme or fragment thereof, a maize or soybean pyruvate,

phosphate dikinase enzyme or fragment thereof or a maize soybean pyrophosphatase enzyme or fragment thereof. As used herein a homologue protein molecule or fragment thereof is a counterpart protein molecule or fragment thereof in a second species (*e.g.*, maize ribulose-bisphosphate carboxylase is a homologue of *Arabidopsis* ribulose-bisphosphate carboxylase).

**(ii) Nucleic Acid Molecule Markers and Probes**

One aspect of the present invention concerns markers that include nucleic acid molecules SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either that can act as markers or other nucleic acid molecules of the present invention that can act as markers.

Genetic markers of the present invention include “dominant” or “codominant” markers “Codominant markers” reveal the presence of two or more alleles (two per diploid individual) at a locus. “Dominant markers” reveal the presence of only a single allele per locus. The presence of the dominant marker phenotype (*e.g.*, a band of DNA) is an indication that one allele is present in either the homozygous or heterozygous condition. The absence of the dominant marker phenotype (*e.g.* absence of a DNA band) is merely evidence that “some other” undefined allele is present. In the case of populations where individuals are predominantly homozygous and loci are predominately dimorphic, dominant and codominant markers can be equally valuable. As populations become more heterozygous and multi-allelic, codominant markers often become more informative of the genotype than dominant markers. Marker molecules can be, for example, capable of detecting polymorphisms such as single nucleotide polymorphisms (SNPs).

SNPs are single base changes in genomic DNA sequence. They occur at greater frequency and are spaced with a greater uniformity throughout a genome than other reported forms of polymorphism. The greater frequency and uniformity of SNPs means that there is

greater probability that such a polymorphism will be found near or in a genetic locus of interest than would be the case for other polymorphisms. SNPs are located in protein-coding regions and noncoding regions of a genome. Some of these SNPs may result in defective or variant protein expression (e.g., as a results of mutations or defective splicing). Analysis (genotyping) of characterized SNPs can require only a plus/minus assay rather than a lengthy measurement, permitting easier automation.

SNPs can be characterized using any of a variety of methods. Such methods include the direct or indirect sequencing of the site, the use of restriction enzymes (Botstein *et al.*, *Am. J. Hum. Genet.* 32:314-331 (1980), the entirety of which is herein incorporated reference; Konieczny and Ausubel, *Plant J.* 4:403-410 (1993), the entirety of which is herein incorporated by reference), enzymatic and chemical mismatch assays (Myers *et al.*, *Nature* 313:495-498 (1985), the entirety of which is herein incorporated by reference), allele-specific PCR (Newton *et al.*, *Nucl. Acids Res.* 17:2503-2516 (1989), the entirety of which is herein incorporated by reference; Wu *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:2757-2760 (1989), the entirety of which is herein incorporated by reference), ligase chain reaction (Barany, *Proc. Natl. Acad. Sci. (U.S.A.)* 88:189-193 (1991), the entirety of which is herein incorporated by reference), single-strand conformation polymorphism analysis (Labrune *et al.*, *Am. J. Hum. Genet.* 48: 1115-1120 (1991), the entirety of which is herein incorporated by reference), primer-directed nucleotide incorporation assays (Kuppuswami *et al.*, *Proc. Natl. Acad. Sci. USA* 88:1143-1147 (1991), the entirety of which is herein incorporated by reference), dideoxy fingerprinting (Sarkar *et al.*, *Genomics* 13:441-443 (1992), the entirety of which is herein incorporated by reference), solid-phase ELISA-based oligonucleotide ligation assays (Nikiforov *et al.*, *Nucl. Acids Res.* 22:4167-4175 (1994), the entirety of which is herein incorporated by reference), oligonucleotide



fluorescence-quenching assays (Livak *et al.*, *PCR Methods Appl.* 4:357-362 (1995), the entirety of which is herein incorporated by reference), 5'-nuclease allele-specific hybridization TaqMan assay (Livak *et al.*, *Nature Genet.* 9:341-342 (1995), the entirety of which is herein incorporated by reference), template-directed dye-terminator incorporation (TDI) assay (Chen and Kwok, *Nucl. Acids Res.* 25:347-353 (1997), the entirety of which is herein incorporated by reference), allele-specific molecular beacon assay (Tyagi *et al.*, *Nature Biotech.* 16: 49-53 (1998), the entirety of which is herein incorporated by reference), PinPoint assay (Haff and Smirnov, *Genome Res.* 7:378-388 (1997), the entirety of which is herein incorporated by reference) and dCAPS analysis (Neff *et al.*, *Plant J.* 14:387-392 (1998), the entirety of which is herein incorporated by reference).

Additional markers, such as AFLP markers, RFLP markers and RAPD markers, can be utilized (Walton, *Seed World* 22-29 (July, 1993), the entirety of which is herein incorporated by reference; Burow and Blake, *Molecular Dissection of Complex Traits*, 13-29, Paterson (ed.), CRC Press, New York (1988), the entirety of which is herein incorporated by reference). DNA markers can be developed from nucleic acid molecules using restriction endonucleases, the PCR and/or DNA sequence information. RFLP markers result from single base changes or insertions/deletions. These codominant markers are highly abundant in plant genomes, have a medium level of polymorphism and are developed by a combination of restriction endonuclease digestion and Southern blotting hybridization. CAPS are similarly developed from restriction nuclease digestion but only of specific PCR products. These markers are also codominant, have a medium level of polymorphism and are highly abundant in the genome. The CAPS result from single base changes and insertions/deletions.

Another marker type, RAPDs, are developed from DNA amplification with random primers and result from single base changes and insertions/deletions in plant genomes. They are dominant markers with a medium level of polymorphisms and are highly abundant. AFLP markers require using the PCR on a subset of restriction fragments from extended adapter primers. These markers are both dominant and codominant are highly abundant in genomes and exhibit a medium level of polymorphism.

SSRs require DNA sequence information. These codominant markers result from repeat length changes, are highly polymorphic and do not exhibit as high a degree of abundance in the genome as CAPS, AFLPs and RAPDs SNPs also require DNA sequence information. These codominant markers result from single base substitutions. They are highly abundant and exhibit a medium of polymorphism (Rafalski *et al.*, In: *Nonmammalian Genomic Analysis*, Birren and Lai (ed.), Academic Press, San Diego, CA, pp. 75-134 (1996), the entirety of which is herein incorporated by reference). It is understood that a nucleic acid molecule of the present invention may be used as a marker.

A PCR probe is a nucleic acid molecule capable of initiating a polymerase activity while in a double-stranded structure to with another nucleic acid. Various methods for determining the structure of PCR probes and PCR techniques exist in the art. Computer generated searches using programs such as Primer3 ([www-genome.wi.mit.edu/cgi-bin/primer/primer3.cgi](http://www-genome.wi.mit.edu/cgi-bin/primer/primer3.cgi)), STSPipeline ([www-genome.wi.mit.edu/cgi-bin/www-STS\\_Pipeline](http://www-genome.wi.mit.edu/cgi-bin/www-STS_Pipeline)), or GeneUp (Pesole *et al.*, *BioTechniques* 25:112-123 (1998) the entirety of which is herein incorporated by reference), for example, can be used to identify potential PCR primers.

It is understood that a fragment of one or more of the nucleic acid molecules of the present invention may be a probe and specifically a PCR probe.

**(b) Protein and Peptide Molecules**

A class of agents comprises one or more of the protein or fragments thereof or peptide molecules encoded by SEQ ID NO: 1 through SEQ ID NO: 7341 or one or more of the protein or fragment thereof and peptide molecules encoded by other nucleic acid agents of the present invention. As used herein, the term "protein molecule" or "peptide molecule" includes any molecule that comprises five or more amino acids. It is well known in the art that proteins may undergo modification, including post-translational modifications, such as, but not limited to, disulfide bond formation, glycosylation, phosphorylation, or oligomerization. Thus, as used herein, the term "protein molecule" or "peptide molecule" includes any protein molecule that is modified by any biological or non-biological process. The terms "amino acid" and "amino acids" refer to all naturally occurring L-amino acids. This definition is meant to include norleucine, ornithine, homocysteine and homoserine.

Non-limiting examples of the protein or fragment thereof of the present invention include a maize or soybean carbon assimilation pathway enzyme or fragment thereof; a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a maize or soybean aldolase enzyme or fragment thereof, a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a maize or soybean transketolase enzyme or fragment thereof, a putative maize or soybean transketolase enzyme or fragment thereof, a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a





for a NADP-dependent malate dehydrogenase enzyme or fragment thereof, SEQ ID NO: 5424 through SEQ ID NO: 5596 and SEQ ID NO: 5601 through SEQ ID NO: 5719 or fragment thereof that encode for an aspartate aminotransferase enzyme or fragment thereof, SEQ ID NO: 5597 through SEQ ID NO: 5600 and SEQ ID NO: 5720 through SEQ ID NO: 5727 or fragment thereof that encode for a putative aspartate aminotransferase enzyme or fragment thereof, SEQ ID NO: 5728 through SEQ ID NO: 5888 and SEQ ID NO: 5889 through SEQ ID NO: 6004 or fragment thereof that encode for an alanine aminotransferase enzyme or fragment thereof, SEQ ID NO: 6005 through SEQ ID NO: 6223 and SEQ ID NO: 6224 through SEQ ID NO: 6287 or fragment thereof that encode for a NADP-dependent malic enzyme or fragment thereof, SEQ ID NO: 6022 through SEQ ID NO: 6023, SEQ ID NO: 6288 through SEQ ID NO: 6290 and SEQ ID NO: 6291 through SEQ ID NO: 6293 or fragment thereof that encodes for a NAD-dependent malic enzyme or fragment thereof, SEQ ID NO: 6294 through SEQ ID NO: 6353 and SEQ ID NO: 6354 through SEQ ID NO: 6387 or fragment thereof that encode for a PEP carboxykinase enzyme or fragment thereof, SEQ ID NO: 6388 or fragment thereof that encode for a putative PEP carboxykinase enzyme or fragment thereof, SEQ ID NO: 6389 through SEQ ID NO: 6847 and SEQ ID NO: 6848 through SEQ ID NO: 6850 or fragment thereof that encode for a pyruvate, phosphate dikinase enzyme or fragment thereof, and SEQ ID NO: 6851 through SEQ ID NO: 7154 and SEQ ID NO: 7155 through SEQ ID NO: 7341 or fragment thereof that encode for a pyrophosphatase enzyme or fragment thereof.

One or more of the protein or fragment of peptide molecules may be produced via chemical synthesis, or more preferably, by expressing in a suitable bacterial or eucaryotic host. Suitable methods for expression are described by Sambrook *et al.*, (In: *Molecular Cloning, A Laboratory Manual, 2nd Edition, Cold Spring Harbor Press, Cold Spring Harbor, New York*

(1989)), or similar texts. For example, the protein may be expressed in, for example, Uses of the Agents of the Invention, Section (a) Plant Constructs and Plant Transformants; Section (b) Fungal Constructs and Fungal Transformants; Section (c) Mammalian Constructs and Transformed Mammalian Cells; Section (d) Insect Constructs and Transformed Insect Cells; and Section (e) Bacterial Constructs and Transformed Bacterial Cells.

A “protein fragment” is a peptide or polypeptide molecule whose amino acid sequence comprises a subset of the amino acid sequence of that protein. A protein or fragment thereof that comprises one or more additional peptide regions not derived from that protein is a “fusion” protein. Such molecules may be derivatized to contain carbohydrate or other moieties (such as keyhole limpet hemocyanin, etc.). Fusion protein or peptide molecules of the present invention are preferably produced via recombinant means.

Another class of agents comprise protein or peptide molecules or fragments or fusions thereof encoded by SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof in which conservative, non-essential or non-relevant amino acid residues have been added, replaced or deleted. Computerized means for designing modifications in protein structure are known in the art (Dahiyat and Mayo, *Science* 278:82-87 (1997), the entirety of which is herein incorporated by reference).

The protein molecules of the present invention include plant homologue proteins. An example of such a homologue is a homologue protein of a non-maize or non-soybean plant species, that include but not limited to alfalfa, *Arabidopsis*, barley, *Brassica*, broccoli, cabbage, citrus, cotton, garlic, oat, oilseed rape, onion, canola, flax, an ornamental plant, pea, peanut, pepper, potato, rice, rye, sorghum, strawberry, sugarcane, sugarbeet, tomato, wheat, poplar, pine, fir, eucalyptus, apple, lettuce, lentils, grape, banana, tea, turf grasses, sunflower, oil palm,

*Phaseolus* etc. Particularly preferred non-maize or non-soybean for use for the isolation of homologs would include, *Arabidopsis*, barley, cotton, oat, oilseed rape, rice, canola, ornamentals, sugarcane, sugarbeet, tomato, potato, wheat and turf grasses. Such a homologue can be obtained by any of a variety of methods. Most preferably, as indicated above, one or more of the disclosed sequences (SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof) will be used to define a pair of primers that may be used to isolate the homologue-encoding nucleic acid molecules from any desired species. Such molecules can be expressed to yield homologues by recombinant means.

### **(c) Antibodies**

One aspect of the present invention concerns antibodies, single-chain antigen binding molecules, or other proteins that specifically bind to one or more of the protein or peptide molecules of the present invention and their homologues, fusions or fragments. Such antibodies may be used to quantitatively or qualitatively detect the protein or peptide molecules of the present invention. As used herein, an antibody or peptide is said to “specifically bind” to a protein or peptide molecule of the present invention if such binding is not competitively inhibited by the presence of non-related molecules.

Nucleic acid molecules that encode all or part of the protein of the present invention can be expressed, via recombinant means, to yield protein or peptides that can in turn be used to elicit antibodies that are capable of binding the expressed protein or peptide. Such antibodies may be used in immunoassays for that protein. Such protein-encoding molecules, or their fragments may be a “fusion” molecule (i.e., a part of a larger nucleic acid molecule) such that, upon expression, a fusion protein is produced. It is understood that any of the nucleic acid molecules of the



present invention may be expressed, via recombinant means, to yield proteins or peptides encoded by these nucleic acid molecules.

The antibodies that specifically bind proteins and protein fragments of the present invention may be polyclonal or monoclonal and may comprise intact immunoglobulins, or antigen binding portions of immunoglobulins fragments (such as  $F(ab')$ ,  $F(ab')_2$ ), or single-chain immunoglobulins producible, for example, via recombinant means. It is understood that practitioners are familiar with the standard resource materials which describe specific conditions and procedures for the construction, manipulation and isolation of antibodies (*see*, for example, Harlow and Lane, In: *Antibodies: A Laboratory Manual*, Cold Spring Harbor Press, Cold Spring Harbor, New York (1988), the entirety of which is herein incorporated by reference).

Murine monoclonal antibodies are particularly preferred. BALB/c mice are preferred for this purpose, however, equivalent strains may also be used. The animals are preferably immunized with approximately 25  $\mu$ g of purified protein (or fragment thereof) that has been emulsified in a suitable adjuvant (such as TiterMax adjuvant (Vaxcel, Norcross, GA)).

Immunization is preferably conducted at two intramuscular sites, one intraperitoneal site and one subcutaneous site at the base of the tail. An additional i.v. injection of approximately 25  $\mu$ g of antigen is preferably given in normal saline three weeks later. After approximately 11 days following the second injection, the mice may be bled and the blood screened for the presence of anti-protein or peptide antibodies. Preferably, a direct binding Enzyme-Linked Immunoassay (ELISA) is employed for this purpose.

More preferably, the mouse having the highest antibody titer is given a third i.v. injection of approximately 25  $\mu$ g of the same protein or fragment. The splenic leukocytes from this

animal may be recovered 3 days later and then permitted to fuse, most preferably, using polyethylene glycol, with cells of a suitable myeloma cell line (such as, for example, the P3X63Ag8.653 myeloma cell line). Hybridoma cells are selected by culturing the cells under "HAT" (hypoxanthine-aminopterin-thymine) selection for about one week. The resulting clones may then be screened for their capacity to produce monoclonal antibodies ("mAbs"), preferably by direct ELISA.

In one embodiment, anti-protein or peptide monoclonal antibodies are isolated using a fusion of a protein or peptide of the present invention, or conjugate of a protein or peptide of the present invention, as immunogens. Thus, for example, a group of mice can be immunized using a fusion protein emulsified in Freund's complete adjuvant (*e.g.* approximately 50 µg of antigen per immunization). At three week intervals, an identical amount of antigen is emulsified in Freund's incomplete adjuvant and used to immunize the animals. Ten days following the third immunization, serum samples are taken and evaluated for the presence of antibody. If antibody titers are too low, a fourth booster can be employed. Polysera capable of binding the protein or peptide can also be obtained using this method.

In a preferred procedure for obtaining monoclonal antibodies, the spleens of the above-described immunized mice are removed, disrupted and immune splenocytes are isolated over a ficoll gradient. The isolated splenocytes are fused, using polyethylene glycol with BALB/c-derived HGPRT (hypoxanthine guanine phosphoribosyl transferase) deficient P3x63xAg8.653 plasmacytoma cells. The fused cells are plated into 96 well microtiter plates and screened for hybridoma fusion cells by their capacity to grow in culture medium supplemented with hypoxanthine, aminopterin and thymidine for approximately 2-3 weeks.

Hybridoma cells that arise from such incubation are preferably screened for their capacity to produce an immunoglobulin that binds to a protein of interest. An indirect ELISA may be used for this purpose. In brief, the supernatants of hybridomas are incubated in microtiter wells that contain immobilized protein. After washing, the titer of bound immunoglobulin can be determined using, for example, a goat anti-mouse antibody conjugated to horseradish peroxidase. After additional washing, the amount of immobilized enzyme is determined (for example through the use of a chromogenic substrate). Such screening is performed as quickly as possible after the identification of the hybridoma in order to ensure that a desired clone is not overgrown by non-secreting neighbor cells. Desirably, the fusion plates are screened several times since the rates of hybridoma growth vary. In a preferred sub-embodiment, a different antigenic form may be used to screen the hybridoma. Thus, for example, the splenocytes may be immunized with one immunogen, but the resulting hybridomas can be screened using a different immunogen. It is understood that any of the protein or peptide molecules of the present invention may be used to raise antibodies.

As discussed below, such antibody molecules or their fragments may be used for diagnostic purposes. Where the antibodies are intended for diagnostic purposes, it may be desirable to derivatize them, for example with a ligand group (such as biotin) or a detectable marker group (such as a fluorescent group, a radioisotope or an enzyme).

The ability to produce antibodies that bind the protein or peptide molecules of the present invention permits the identification of mimetic compounds of those molecules. A "mimetic compound" is a compound that is not that compound, or a fragment of that compound, but which nonetheless exhibits an ability to specifically bind to antibodies directed against that compound.

It is understood that any of the agents of the present invention can be substantially purified and/or be biologically active and/or recombinant.

### **Uses of the Agents of the Invention**

Nucleic acid molecules and fragments thereof of the present invention may be employed to obtain other nucleic acid molecules from the same species (e.g., ESTs or fragment thereof from maize may be utilized to obtain other nucleic acid molecules from maize). Such nucleic acid molecules include the nucleic acid molecules that encode the complete coding sequence of a protein and promoters and flanking sequences of such molecules. In addition, such nucleic acid molecules include nucleic acid molecules that encode for other isozymes or gene family members. Such molecules can be readily obtained by using the above-described nucleic acid molecules or fragments thereof to screen cDNA or genomic libraries obtained from maize or soybean. Methods for forming such libraries are well known in the art.

Nucleic acid molecules and fragments thereof of the present invention may also be employed to obtain nucleic acid homologues. Such homologues include the nucleic acid molecule of other plants or other organisms (e.g., alfalfa, *Arabidopsis*, barley, *Brassica*, broccoli, cabbage, citrus, cotton, garlic, oat, oilseed rape, onion, canola, flax, an ornamental plant, pea, peanut, pepper, potato, rice, rye, sorghum, strawberry, sugarcane, sugarbeet, tomato, wheat, poplar, pine, fir, eucalyptus, apple, lettuce, lentils, grape, banana, tea, turf grasses, sunflower, oil palm, *Phaseolus*, etc.) including the nucleic acid molecules that encode, in whole or in part, protein homologues of other plant species or other organisms, sequences of genetic elements such as promoters and transcriptional regulatory elements. Such molecules can be readily obtained by using the above-described nucleic acid molecules or fragments thereof to screen cDNA or genomic libraries obtained from such plant species. Methods for forming such libraries

are well known in the art. Such homologue molecules may differ in their nucleotide sequences from those found in one or more of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof because complete complementarity is not needed for stable hybridization. The nucleic acid molecules of the present invention therefore also include molecules that, although capable of specifically hybridizing with the nucleic acid molecules may lack "complete complementarity."

Any of a variety of methods may be used to obtain one or more of the above-described nucleic acid molecules (Zamechik *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 83:4143-4146 (1986), the entirety of which is herein incorporated by reference; Goodchild *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 85:5507-5511 (1988), the entirety of which is herein incorporated by reference; Wickstrom *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 85:1028-1032 (1988), the entirety of which is herein incorporated by reference; Holt *et al.*, *Molec. Cell. Biol.* 8:963-973 (1988), the entirety of which is herein incorporated by reference; Gerwitz *et al.*, *Science* 242:1303-1306 (1988), the entirety of which is herein incorporated by reference; Anfossi *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:3379-3383 (1989), the entirety of which is herein incorporated by reference; Becker *et al.*, *EMBO J.* 8:3685-3691 (1989); the entirety of which is herein incorporated by reference). Automated nucleic acid synthesizers may be employed for this purpose. In lieu of such synthesis, the disclosed nucleic acid molecules may be used to define a pair of primers that can be used with the polymerase chain reaction (Mullis *et al.*, *Cold Spring Harbor Symp. Quant. Biol.* 51:263-273 (1986); Erlich *et al.*, European Patent 50,424; European Patent 84,796; European Patent 258,017; European Patent 237,362; Mullis, European Patent 201,184; Mullis *et al.*, U.S. Patent No. 4,683,202; Erlich, U.S. Patent No. 4,582,788; and Saiki *et al.*, U.S. Patent No. 4,683,194, all of which are herein incorporated by reference in their entirety) to amplify and obtain any desired nucleic acid molecule or fragment.

Promoter sequence(s) and other genetic elements, including but not limited to transcriptional regulatory flanking sequences, associated with one or more of the disclosed nucleic acid sequences can also be obtained using the disclosed nucleic acid sequence provided herein. In one embodiment, such sequences are obtained by incubating EST nucleic acid molecules or preferably fragments thereof with members of genomic libraries (*e.g.* maize and soybean) and recovering clones that hybridize to the EST nucleic acid molecule or fragment thereof. In a second embodiment, methods of "chromosome walking," or inverse PCR may be used to obtain such sequences (Frohman *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 85:8998-9002 (1988); Ohara *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:5673-5677 (1989); Pang *et al.*, *Biotechniques* 22:1046-1048 (1977); Huang *et al.*, *Methods Mol. Biol.* 69:89-96 (1997); Huang *et al.*, *Method Mol. Biol.* 67:287-294 (1997); Benkel *et al.*, *Genet. Anal.* 13:123-127 (1996); Hartl *et al.*, *Methods Mol. Biol.* 58:293-301 (1996), all of which are herein incorporated by reference in their entirety).

The nucleic acid molecules of the present invention may be used to isolate promoters of cell enhanced, cell specific, tissue enhanced, tissue specific, developmentally or environmentally regulated expression profiles. Isolation and functional analysis of the 5' flanking promoter sequences of these genes from genomic libraries, for example, using genomic screening methods and PCR techniques would result in the isolation of useful promoters and transcriptional regulatory elements. These methods are known to those of skill in the art and have been described (See, for example, Birren *et al.*, *Genome Analysis: Analyzing DNA*, 1, (1997), Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., the entirety of which is herein incorporated by reference). Promoters obtained utilizing the nucleic acid molecules of the present invention could also be modified to affect their control characteristics. Examples of such

modifications would include but are not limited to enhanced sequences as reported in Uses of the Agents of the Invention, Section (a) Plant Constructs and Plant Transformants. Such genetic elements could be used to enhance gene expression of new and existing traits for crop improvements.

In one sub-aspect, such an analysis is conducted by determining the presence and/or identity of polymorphism(s) by one or more of the nucleic acid molecules of the present invention and more preferably one or more of the EST nucleic acid molecule or fragment thereof which are associated with a phenotype, or a predisposition to that phenotype.

Any of a variety of molecules can be used to identify such polymorphism(s). In one embodiment, one or more of the EST nucleic acid molecules (or a sub-fragment thereof) may be employed as a marker nucleic acid molecule to identify such polymorphism(s). Alternatively, such polymorphisms can be detected through the use of a marker nucleic acid molecule or a marker protein that is genetically linked to (i.e., a polynucleotide that co-segregates with) such polymorphism(s).

In an alternative embodiment, such polymorphisms can be detected through the use of a marker nucleic acid molecule that is physically linked to such polymorphism(s). For this purpose, marker nucleic acid molecules comprising a nucleotide sequence of a polynucleotide located within 1mb of the polymorphism(s) and more preferably within 100kb of the polymorphism(s) and most preferably within 10kb of the polymorphism(s) can be employed.

The genomes of animals and plants naturally undergo spontaneous mutation in the course of their continuing evolution (Gusella, *Ann. Rev. Biochem.* 55:831-854 (1986)). A “polymorphism” is a variation or difference in the sequence of the gene or its flanking regions that arises in some of the members of a species. The variant sequence and the “original”

sequence co-exist in the species' population. In some instances, such co-existence is in stable or quasi-stable equilibrium.

A polymorphism is thus said to be "allelic," in that, due to the existence of the polymorphism, some members of a species may have the original sequence (i.e., the original "allele") whereas other members may have the variant sequence (i.e., the variant "allele"). In the simplest case, only one variant sequence may exist and the polymorphism is thus said to be di-allelic. In other cases, the species' population may contain multiple alleles and the polymorphism is termed tri-allelic, etc. A single gene may have multiple different unrelated polymorphisms. For example, it may have a di-allelic polymorphism at one site and a multi-allelic polymorphism at another site.

The variation that defines the polymorphism may range from a single nucleotide variation to the insertion or deletion of extended regions within a gene. In some cases, the DNA sequence variations are in regions of the genome that are characterized by short tandem repeats (STRs) that include tandem di- or tri-nucleotide repeated motifs of nucleotides. Polymorphisms characterized by such tandem repeats are referred to as "variable number tandem repeat" ("VNTR") polymorphisms. VNTRs have been used in identity analysis (Weber, U.S. Patent No. 5,075,217; Armour *et al.*, *FEBS Lett.* 307:113-115 (1992); Jones *et al.*, *Eur. J. Haematol.* 39:144-147 (1987); Horn *et al.*, PCT Patent Application WO91/14003; Jeffreys, European Patent Application 370,719; Jeffreys, U.S. Patent No. 5,175,082; Jeffreys *et al.*, *Amer. J. Hum. Genet.* 39:11-24 (1986); Jeffreys *et al.*, *Nature* 316:76-79 (1985); Gray *et al.*, *Proc. R. Acad. Soc. Lond.* 243:241-253 (1991); Moore *et al.*, *Genomics* 10:654-660 (1991); Jeffreys *et al.*, *Anim. Genet.* 18:1-15 (1987); Hillel *et al.*, *Anim. Genet.* 20:145-155 (1989); Hillel *et al.*, *Genet.* 124:783-789 (1990), all of which are herein incorporated by reference in their entirety).



The detection of polymorphic sites in a sample of DNA may be facilitated through the use of nucleic acid amplification methods. Such methods specifically increase the concentration of polynucleotides that span the polymorphic site, or include that site and sequences located either distal or proximal to it. Such amplified molecules can be readily detected by gel electrophoresis or other means.

The most preferred method of achieving such amplification employs the polymerase chain reaction ("PCR") (Mullis *et al.*, *Cold Spring Harbor Symp. Quant. Biol.* 51:263-273 (1986); Erlich *et al.*, European Patent Appln. 50,424; European Patent Appln. 84,796; European Patent Application 258,017; European Patent Appln. 237,362; Mullis, European Patent Appln. 201,184; Mullis *et al.*, U.S. Patent No. 4,683,202; Erlich, U.S. Patent No. 4,582,788; and Saiki *et al.*, U.S. Patent No. 4,683,194), using primer pairs that are capable of hybridizing to the proximal sequences that define a polymorphism in its double-stranded form.

In lieu of PCR, alternative methods, such as the "Ligase Chain Reaction" ("LCR") may be used (Barany, *Proc. Natl. Acad. Sci. (U.S.A.)* 88:189-193 (1991), the entirety of which is herein incorporated by reference). LCR uses two pairs of oligonucleotide probes to exponentially amplify a specific target. The sequences of each pair of oligonucleotides is selected to permit the pair to hybridize to abutting sequences of the same strand of the target. Such hybridization forms a substrate for a template-dependent ligase. As with PCR, the resulting products thus serve as a template in subsequent cycles and an exponential amplification of the desired sequence is obtained.

LCR can be performed with oligonucleotides having the proximal and distal sequences of the same strand of a polymorphic site. In one embodiment, either oligonucleotide will be designed to include the actual polymorphic site of the polymorphism. In such an embodiment,

the reaction conditions are selected such that the oligonucleotides can be ligated together only if the target molecule either contains or lacks the specific nucleotide that is complementary to the polymorphic site present on the oligonucleotide. Alternatively, the oligonucleotides may be selected such that they do not include the polymorphic site (see, Segev, PCT Application WO 90/01069, the entirety of which is herein incorporated by reference).

The "Oligonucleotide Ligation Assay" ("OLA") may alternatively be employed (Landegren *et al.*, *Science* 241:1077-1080 (1988), the entirety of which is herein incorporated by reference). The OLA protocol uses two oligonucleotides which are designed to be capable of hybridizing to abutting sequences of a single strand of a target. OLA, like LCR, is particularly suited for the detection of point mutations. Unlike LCR, however, OLA results in "linear" rather than exponential amplification of the target sequence.

Nickerson *et al.*, have described a nucleic acid detection assay that combines attributes of PCR and OLA (Nickerson *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 87:8923-8927 (1990), the entirety of which is herein incorporated by reference). In this method, PCR is used to achieve the exponential amplification of target DNA, which is then detected using OLA. In addition to requiring multiple and separate, processing steps, one problem associated with such combinations is that they inherit all of the problems associated with PCR and OLA.

Schemes based on ligation of two (or more) oligonucleotides in the presence of nucleic acid having the sequence of the resulting "di-oligonucleotide", thereby amplifying the di-oligonucleotide, are also known (Wu *et al.*, *Genomics* 4:560-569 (1989), the entirety of which is herein incorporated by reference) and may be readily adapted to the purposes of the present invention.

Other known nucleic acid amplification procedures, such as allele-specific oligomers, branched DNA technology, transcription-based amplification systems, or isothermal amplification methods may also be used to amplify and analyze such polymorphisms (Malek *et al.*, U.S. Patent No. 5,130,238; Davey *et al.*, European Patent Application 329,822; Schuster *et al.*, U.S. Patent No. 5,169,766; Miller *et al.*, PCT Patent Application WO 89/06700; Kwoh *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:1173-1177 (1989); Gingeras *et al.*, PCT Patent Application WO 88/10315; Walker *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 89:392-396 (1992), all of which are herein incorporated by reference in their entirety).

The identification of a polymorphism can be determined in a variety of ways. By correlating the presence or absence of it in a plant with the presence or absence of a phenotype, it is possible to predict the phenotype of that plant. If a polymorphism creates or destroys a restriction endonuclease cleavage site, or if it results in the loss or insertion of DNA (e.g., a VNTR polymorphism), it will alter the size or profile of the DNA fragments that are generated by digestion with that restriction endonuclease. As such, individuals that possess a variant sequence can be distinguished from those having the original sequence by restriction fragment analysis. Polymorphisms that can be identified in this manner are termed "restriction fragment length polymorphisms" ("RFLPs"). RFLPs have been widely used in human and plant genetic analyses (Glassberg, UK Patent Application 2135774; Skolnick *et al.*, *Cytogen. Cell Genet.* 32:58-67 (1982); Botstein *et al.*, *Ann. J. Hum. Genet.* 32:314-331 (1980); Fischer *et al.*, (PCT Application WO90/13668); Uhlen, PCT Application WO90/11369).

Polymorphisms can also be identified by Single Strand Conformation Polymorphism (SSCP) analysis. SSCP is a method capable of identifying most sequence variations in a single strand of DNA, typically between 150 and 250 nucleotides in length (Elles, *Methods in*

*Molecular Medicine: Molecular Diagnosis of Genetic Diseases*, Humana Press (1996), the entirety of which is herein incorporated by reference); Orita *et al.*, *Genomics* 5:874-879 (1989), the entirety of which is herein incorporated by reference). Under denaturing conditions a single strand of DNA will adopt a conformation that is uniquely dependent on its sequence conformation. This conformation usually will be different, even if only a single base is changed. Most conformations have been reported to alter the physical configuration or size sufficiently to be detectable by electrophoresis. A number of protocols have been described for SSCP including, but not limited to, Lee *et al.*, *Anal. Biochem.* 205:289-293 (1992), the entirety of which is herein incorporated by reference; Suzuki *et al.*, *Anal. Biochem.* 192:82-84 (1991), the entirety of which is herein incorporated by reference; Lo *et al.*, *Nucleic Acids Research* 20:1005-1009 (1992), the entirety of which is herein incorporated by reference; Sarkar *et al.*, *Genomics* 13:441-443 (1992), the entirety of which is herein incorporated by reference. It is understood that one or more of the nucleic acids of the present invention, may be utilized as markers or probes to detect polymorphisms by SSCP analysis.

Polymorphisms may also be found using a DNA fingerprinting technique called amplified fragment length polymorphism (AFLP), which is based on the selective PCR amplification of restriction fragments from a total digest of genomic DNA to profile that DNA (Vos *et al.*, *Nucleic Acids Res.* 23:4407-4414 (1995), the entirety of which is herein incorporated by reference). This method allows for the specific co-amplification of high numbers of restriction fragments, which can be visualized by PCR without knowledge of the nucleic acid sequence.

AFLP employs basically three steps. Initially, a sample of genomic DNA is cut with restriction enzymes and oligonucleotide adapters are ligated to the restriction fragments of the

DNA. The restriction fragments are then amplified using PCR by using the adapter and restriction sequence as target sites for primer annealing. The selective amplification is achieved by the use of primers that extend into the restriction fragments, amplifying only those fragments in which the primer extensions match the nucleotide flanking the restriction sites. These amplified fragments are then visualized on a denaturing polyacrylamide gel.

AFLP analysis has been performed on *Salix* (Beismann *et al.*, *Mol. Ecol.* 6:989-993 (1997), the entirety of which is herein incorporated by reference), *Acinetobacter* (Janssen *et al.*, *Int. J. Syst. Bacteriol.* 47:1179-1187 (1997), the entirety of which is herein incorporated by reference), *Aeromonas popoffi* (Huys *et al.*, *Int. J. Syst. Bacteriol.* 47:1165-1171 (1997), the entirety of which is herein incorporated by reference), rice (McCouch *et al.*, *Plant Mol. Biol.* 35:89-99 (1997), the entirety of which is herein incorporated by reference; Nandi *et al.*, *Mol. Gen. Genet.* 255:1-8 (1997), the entirety of which is herein incorporated by reference; Cho *et al.*, *Genome* 39:373-378 (1996), the entirety of which is herein incorporated by reference), barley (*Hordeum vulgare*)(Simons *et al.*, *Genomics* 44:61-70 (1997), the entirety of which is herein incorporated by reference; Waugh *et al.*, *Mol. Gen. Genet.* 255:311-321 (1997), the entirety of which is herein incorporated by reference; Qi *et al.*, *Mol. Gen. Genet.* 254:330-336 (1997), the entirety of which is herein incorporated by reference; Becker *et al.*, *Mol. Gen. Genet.* 249:65-73 (1995), the entirety of which is herein incorporated by reference), potato (Van der Voort *et al.*, *Mol. Gen. Genet.* 255:438-447 (1997), the entirety of which is herein incorporated by reference; Meksem *et al.*, *Mol. Gen. Genet.* 249:74-81 (1995), the entirety of which is herein incorporated by reference), *Phytophthora infestans* (Van der Lee *et al.*, *Fungal Genet. Biol.* 21:278-291 (1997), the entirety of which is herein incorporated by reference), *Bacillus anthracis* (Keim *et al.*, *J. Bacteriol.* 179:818-824 (1997), the entirety of which is herein incorporated by reference),

*Astragalus cremnophylax* (Travis *et al.*, *Mol. Ecol.* 5:735-745 (1996), the entirety of which is herein incorporated by reference), *Arabidopsis* (Cnops *et al.*, *Mol. Gen. Genet.* 253:32-41 (1996), the entirety of which is herein incorporated by reference), *Escherichia coli* (Lin *et al.*, *Nucleic Acids Res.* 24:3649-3650 (1996), the entirety of which is herein incorporated by reference), *Aeromonas* (Huys *et al.*, *Int. J. Syst. Bacteriol.* 46:572-580 (1996), the entirety of which is herein incorporated by reference), nematode (Folkertsma *et al.*, *Mol. Plant Microbe Interact.* 9:47-54 (1996), the entirety of which is herein incorporated by reference), tomato (Thomas *et al.*, *Plant J.* 8:785-794 (1995), the entirety of which is herein incorporated by reference) and human (Latorra *et al.*, *PCR Methods Appl.* 3:351-358 (1994), the entirety of which is herein incorporated by reference). AFLP analysis has also been used for fingerprinting mRNA (Money *et al.*, *Nucleic Acids Res.* 24:2616-2617 (1996), the entirety of which is herein incorporated by reference; Bachem *et al.*, *Plant J.* 9:745-753 (1996), the entirety of which is herein incorporated by reference). It is understood that one or more of the nucleic acids of the present invention, may be utilized as markers or probes to detect polymorphisms by AFLP analysis or for fingerprinting RNA.

Polymorphisms may also be found using random amplified polymorphic DNA (RAPD) (Williams *et al.*, *Nucl. Acids Res.* 18:6531-6535 (1990), the entirety of which is herein incorporated by reference) and cleaveable amplified polymorphic sequences (CAPS) (Lyamichev *et al.*, *Science* 260:778-783 (1993), the entirety of which is herein incorporated by reference). It is understood that one or more of the nucleic acid molecules of the present invention, may be utilized as markers or probes to detect polymorphisms by RAPD or CAPS analysis.

Through genetic mapping, a fine scale linkage map can be developed using DNA markers and, then, a genomic DNA library of large-sized fragments can be screened with molecular

markers linked to the desired trait. Molecular markers are advantageous for agronomic traits that are otherwise difficult to tag, such as resistance to pathogens, insects and nematodes, tolerance to abiotic stress, quality parameters and quantitative traits such as high yield potential.

The essential requirements for marker-assisted selection in a plant breeding program are: (1) the marker(s) should co-segregate or be closely linked with the desired trait; (2) an efficient means of screening large populations for the molecular marker(s) should be available; and (3) the screening technique should have high reproducibility across laboratories and preferably be economical to use and be user-friendly.

The genetic linkage of marker molecules can be established by a gene mapping model such as, without limitation, the flanking marker model reported by Lander and Botstein, *Genetics* 121:185-199 (1989) and the interval mapping, based on maximum likelihood methods described by Lander and Botstein, *Genetics* 121:185-199 (1989) and implemented in the software package MAPMAKER/QTL (Lincoln and Lander, *Mapping Genes Controlling Quantitative Traits Using MAPMAKER/QTL*, Whitehead Institute for Biomedical Research, Massachusetts, (1990). Additional software includes Qgene, Version 2.23 (1996), Department of Plant Breeding and Biometry, 266 Emerson Hall, Cornell University, Ithaca, NY, the manual of which is herein incorporated by reference in its entirety). Use of Qgene software is a particularly preferred approach.

A maximum likelihood estimate (MLE) for the presence of a marker is calculated, together with an MLE assuming no QTL effect, to avoid false positives. A  $\log_{10}$  of an odds ratio (LOD) is then calculated as:  $LOD = \log_{10}(\text{MLE for the presence of a QTL} / \text{MLE given no linked QTL})$ .

The LOD score essentially indicates how much more likely the data are to have arisen assuming the presence of a QTL than in its absence. The LOD threshold value for avoiding a false positive with a given confidence, say 95%, depends on the number of markers and the length of the genome. Graphs indicating LOD thresholds are set forth in Lander and Botstein, *Genetics* 121:185-199 (1989) the entirety of which is herein incorporated by reference and further described by Arús and Moreno-González, *Plant Breeding*, Hayward *et al.*, (eds.) Chapman & Hall, London, pp. 314-331 (1993), the entirety of which is herein incorporated by reference.

Additional models can be used. Many modifications and alternative approaches to interval mapping have been reported, including the use non-parametric methods (Kruglyak and Lander, *Genetics* 139:1421-1428 (1995), the entirety of which is herein incorporated by reference). Multiple regression methods or models can be also be used, in which the trait is regressed on a large number of markers (Jansen, *Biometrics in Plant Breeding*, van Oijen and Jansen (eds.), Proceedings of the Ninth Meeting of the Eucarpia Section Biometrics in Plant Breeding, The Netherlands, pp. 116-124 (1994); Weber and Wricke, *Advances in Plant Breeding*, Blackwell, Berlin, 16 (1994), both of which is herein incorporated by reference in their entirety). Procedures combining interval mapping with regression analysis, whereby the phenotype is regressed onto a single putative QTL at a given marker interval and at the same time onto a number of markers that serve as 'cofactors,' have been reported by Jansen and Stam, *Genetics* 136:1447-1455 (1994), the entirety of which is herein incorporated by reference and Zeng, *Genetics* 136:1457-1468 (1994) the entirety of which is herein incorporated by reference. Generally, the use of cofactors reduces the bias and sampling error of the estimated QTL positions (Utz and Melchinger, *Biometrics in Plant Breeding*, van Oijen and Jansen (eds.)



Proceedings of the Ninth Meeting of the Eucarpia Section Biometrics in Plant Breeding, The Netherlands, pp.195-204 (1994), the entirety of which is herein incorporated by reference, thereby improving the precision and efficiency of QTL mapping (Zeng, *Genetics* 136:1457-1468 (1994)). These models can be extended to multi-environment experiments to analyze genotype-environment interactions (Jansen *et al.*, *Theo. Appl. Genet.* 91:33-37 (1995), the entirety of which is herein incorporated by reference).

Selection of an appropriate mapping populations is important to map construction. The choice of appropriate mapping population depends on the type of marker systems employed (Tanksley *et al.*, *Molecular mapping plant chromosomes. Chromosome structure and function: Impact of new concepts*, Gustafson and Appels (eds.), Plenum Press, New York, pp 157-173 (1988), the entirety of which is herein incorporated by reference). Consideration must be given to the source of parents (adapted vs. exotic) used in the mapping population. Chromosome pairing and recombination rates can be severely disturbed (suppressed) in wide crosses (adapted x exotic) and generally yield greatly reduced linkage distances. Wide crosses will usually provide segregating populations with a relatively large array of polymorphisms when compared to progeny in a narrow cross (adapted x adapted).

An  $F_2$  population is the first generation of selfing after the hybrid seed is produced. Usually a single  $F_1$  plant is selfed to generate a population segregating for all the genes in Mendelian (1:2:1) fashion. Maximum genetic information is obtained from a completely classified  $F_2$  population using a codominant marker system (Mather, *Measurement of Linkage in Heredity*, Methuen and Co., (1938), the entirety of which is herein incorporated by reference). In the case of dominant markers, progeny tests (e.g.  $F_3$ ,  $BCF_2$ ) are required to identify the heterozygotes, thus making it equivalent to a completely classified  $F_2$  population. However, this

procedure is often prohibitive because of the cost and time involved in progeny testing. Progeny testing of  $F_2$  individuals is often used in map construction where phenotypes do not consistently reflect genotype (e.g. disease resistance) or where trait expression is controlled by a QTL. Segregation data from progeny test populations (e.g.  $F_3$  or  $BCF_2$ ) can be used in map construction. Marker-assisted selection can then be applied to cross progeny based on marker-trait map associations ( $F_2$ ,  $F_3$ ), where linkage groups have not been completely disassociated by recombination events (i.e., maximum disequilibrium).

Recombinant inbred lines (RIL) (genetically related lines; usually  $>F_5$ , developed from continuously selfing  $F_2$  lines towards homozygosity) can be used as a mapping population. Information obtained from dominant markers can be maximized by using RIL because all loci are homozygous or nearly so. Under conditions of tight linkage (i.e., about  $<10\%$  recombination), dominant and co-dominant markers evaluated in RIL populations provide more information per individual than either marker type in backcross populations (Reiter *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 89:1477-1481 (1992), the entirety of which is herein incorporated by reference). However, as the distance between markers becomes larger (i.e., loci become more independent), the information in RIL populations decreases dramatically when compared to codominant markers.

Backcross populations (e.g., generated from a cross between a successful variety (recurrent parent) and another variety (donor parent) carrying a trait not present in the former) can be utilized as a mapping population. A series of backcrosses to the recurrent parent can be made to recover most of its desirable traits. Thus a population is created consisting of individuals nearly like the recurrent parent but each individual carries varying amounts or mosaic of genomic regions from the donor parent. Backcross populations can be useful for mapping

dominant markers if all loci in the recurrent parent are homozygous and the donor and recurrent parent have contrasting polymorphic marker alleles (Reiter *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 89:1477-1481 (1992)). Information obtained from backcross populations using either codominant or dominant markers is less than that obtained from F<sub>2</sub> populations because one, rather than two, recombinant gametes are sampled per plant. Backcross populations, however, are more informative (at low marker saturation) when compared to RILs as the distance between linked loci increases in RIL populations (i.e. about 15% recombination). Increased recombination can be beneficial for resolution of tight linkages, but may be undesirable in the construction of maps with low marker saturation.

Near-isogenic lines (NIL) created by many backcrosses to produce an array of individuals that are nearly identical in genetic composition except for the trait or genomic region under interrogation can be used as a mapping population. In mapping with NILs, only a portion of the polymorphic loci are expected to map to a selected region.

Bulk segregant analysis (BSA) is a method developed for the rapid identification of linkage between markers and traits of interest (Michelmore *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 88:9828-9832 (1991), the entirety of which is herein incorporated by reference). In BSA, two bulked DNA samples are drawn from a segregating population originating from a single cross. These bulks contain individuals that are identical for a particular trait (resistant or susceptible to particular disease) or genomic region but arbitrary at unlinked regions (i.e. heterozygous). Regions unlinked to the target region will not differ between the bulked samples of many individuals in BSA.

It is understood that one or more of the nucleic acid molecules of the present invention may be used as molecular markers. It is also understood that one or more of the protein molecules of the present invention may be used as molecular markers.

In accordance with this aspect of the present invention, a sample nucleic acid is obtained from plants cells or tissues. Any source of nucleic acid may be used. Preferably, the nucleic acid is genomic DNA. The nucleic acid is subjected to restriction endonuclease digestion. For example, one or more nucleic acid molecule or fragment thereof of the present invention can be used as a probe in accordance with the above-described polymorphic methods. The polymorphism obtained in this approach can then be cloned to identify the mutation at the coding region which alters the protein's structure or regulatory region of the gene which affects its expression level.

In an aspect of the present invention, one or more of the nucleic molecules of the present invention are used to determine the level (i.e., the concentration of mRNA in a sample, etc.) in a plant (preferably maize or soybean) or pattern (i.e., the kinetics of expression, rate of decomposition, stability profile, etc.) of the expression of a protein encoded in part or whole by one or more of the nucleic acid molecule of the present invention (collectively, the "Expression Response" of a cell or tissue). As used herein, the Expression Response manifested by a cell or tissue is said to be "altered" if it differs from the Expression Response of cells or tissues of plants not exhibiting the phenotype. To determine whether an Expression Response is altered, the Expression Response manifested by the cell or tissue of the plant exhibiting the phenotype is compared with that of a similar cell or tissue sample of a plant not exhibiting the phenotype. As will be appreciated, it is not necessary to re-determine the Expression Response of the cell or tissue sample of plants not exhibiting the phenotype each time such a comparison is made;

rather, the Expression Response of a particular plant may be compared with previously obtained values of normal plants. As used herein, the phenotype of the organism is any of one or more characteristics of an organism (e.g. disease resistance, pest tolerance, environmental tolerance such as tolerance to abiotic stress, male sterility, quality improvement or yield etc.). A change in genotype or phenotype may be transient or permanent. Also as used herein, a tissue sample is any sample that comprises more than one cell. In a preferred aspect, a tissue sample comprises cells that share a common characteristic (e.g. derived from root, seed, flower, leaf, stem or pollen etc.).

In one aspect of the present invention, an evaluation can be conducted to determine whether a particular mRNA molecule is present. One or more of the nucleic acid molecules of the present invention, preferably one or more of the EST nucleic acid molecules or fragments thereof of the present invention are utilized to detect the presence or quantity of the mRNA species. Such molecules are then incubated with cell or tissue extracts of a plant under conditions sufficient to permit nucleic acid hybridization. The detection of double-stranded probe-mRNA hybrid molecules is indicative of the presence of the mRNA; the amount of such hybrid formed is proportional to the amount of mRNA. Thus, such probes may be used to ascertain the level and extent of the mRNA production in a plant's cells or tissues. Such nucleic acid hybridization may be conducted under quantitative conditions (thereby providing a numerical value of the amount of the mRNA present). Alternatively, the assay may be conducted as a qualitative assay that indicates either that the mRNA is present, or that its level exceeds a user set, predefined value.

A principle of *in situ* hybridization is that a labeled, single-stranded nucleic acid probe will hybridize to a complementary strand of cellular DNA or RNA and, under the appropriate

conditions, these molecules will form a stable hybrid. When nucleic acid hybridization is combined with histological techniques, specific DNA or RNA sequences can be identified within a single cell. An advantage of *in situ* hybridization over more conventional techniques for the detection of nucleic acids is that it allows an investigator to determine the precise spatial population (Angerer *et al.*, *Dev. Biol.* 101:477-484 (1984), the entirety of which is herein incorporated by reference; Angerer *et al.*, *Dev. Biol.* 112:157-166 (1985), the entirety of which is herein incorporated by reference; Dixon *et al.*, *EMBO J.* 10:1317-1324 (1991), the entirety of which is herein incorporated by reference). *In situ* hybridization may be used to measure the steady-state level of RNA accumulation. It is a sensitive technique and RNA sequences present in as few as 5-10 copies per cell can be detected (Hardin *et al.*, *J. Mol. Biol.* 202:417-431 (1989), the entirety of which is herein incorporated by reference). A number of protocols have been devised for *in situ* hybridization, each with tissue preparation, hybridization and washing conditions (Meyerowitz, *Plant Mol. Biol. Rep.* 5:242-250 (1987), the entirety of which is herein incorporated by reference; Cox and Goldberg, In: *Plant Molecular Biology: A Practical Approach*, Shaw (ed.), pp 1-35, IRL Press, Oxford (1988), the entirety of which is herein incorporated by reference; Raikhel *et al.*, *In situ RNA hybridization in plant tissues*, In: *Plant Molecular Biology Manual*, vol. B9:1-32, Kluwer Academic Publisher, Dordrecht, Belgium (1989), the entirety of which is herein incorporated by reference).

*In situ* hybridization also allows for the localization of proteins within a tissue or cell (Wilkinson, *In Situ Hybridization*, Oxford University Press, Oxford (1992), the entirety of which is herein incorporated by reference; Langdale, *In Situ Hybridization* In: *The Maize Handbook*, Freeling and Walbot (eds.), pp 165-179, Springer-Verlag, New York (1994), the entirety of which is herein incorporated by reference). It is understood that one or more of the molecules of

the present invention, preferably one or more of the EST nucleic acid molecules or fragments thereof of the present invention or one or more of the antibodies of the present invention may be utilized to detect the level or pattern of a carbon assimilation pathway enzyme or mRNA thereof by *in situ* hybridization.

Fluorescent *in situ* hybridization allows the localization of a particular DNA sequence along a chromosome which is useful, among other uses, for gene mapping, following chromosomes in hybrid lines or detecting chromosomes with translocations, transversions or deletions. *In situ* hybridization has been used to identify chromosomes in several plant species (Griffor *et al.*, *Plant Mol. Biol.* 17:101-109 (1991), the entirety of which is herein incorporated by reference; Gustafson *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 87:1899-1902 (1990), herein incorporated by reference; Mukai and Gill, *Genome* 34:448-452 (1991), the entirety of which is herein incorporated by reference; Schwarzacher and Heslop-Harrison, *Genome* 34:317-323 (1991); Wang *et al.*, *Jpn. J. Genet.* 66:313-316 (1991), the entirety of which is herein incorporated by reference; Parra and Windle, *Nature Genetics* 5:17-21 (1993), the entirety of which is herein incorporated by reference). It is understood that the nucleic acid molecules of the present invention may be used as probes or markers to localize sequences along a chromosome.

Another method to localize the expression of a molecule is tissue printing. Tissue printing provides a way to screen, at the same time on the same membrane many tissue sections from different plants or different developmental stages. Tissue-printing procedures utilize films designed to immobilize proteins and nucleic acids. In essence, a freshly cut section of a tissue is pressed gently onto nitrocellulose paper, nylon membrane or polyvinylidene difluoride membrane. Such membranes are commercially available (*e.g.* Millipore, Bedford, Massachusetts U.S.A.). The contents of the cut cell transfer onto the membrane and the contents and are

immobilized to the membrane. The immobilized contents form a latent print that can be visualized with appropriate probes. When a plant tissue print is made on nitrocellulose paper, the cell walls leave a physical print that makes the anatomy visible without further treatment (Varner and Taylor, *Plant Physiol.* 91:31-33 (1989), the entirety of which is herein incorporated by reference).

Tissue printing on substrate films is described by Daoust, *Exp. Cell Res.* 12:203-211 (1957), the entirety of which is herein incorporated by reference, who detected amylase, protease, ribonuclease and deoxyribonuclease in animal tissues using starch, gelatin and agar films. These techniques can be applied to plant tissues (Yomo and Taylor, *Planta* 112:35-43 (1973); the entirety of which is herein incorporated by reference; Harris and Chrispeels, *Plant Physiol.* 56:292-299 (1975), the entirety of which is herein incorporated by reference). Advances in membrane technology have increased the range of applications of Daoust's tissue-printing techniques allowing (Cassab and Varner, *J. Cell. Biol.* 105:2581-2588 (1987), the entirety of which is herein incorporated by reference) the histochemical localization of various plant enzymes and deoxyribonuclease on nitrocellulose paper and nylon (Spruce *et al.*, *Phytochemistry* 26:2901-2903 (1987), the entirety of which is herein incorporated by reference; Barres *et al.*, *Neuron* 5:527-544 (1990), the entirety of which is herein incorporated by reference; Reid and Pont-Lezica, *Tissue Printing: Tools for the Study of Anatomy, Histochemistry and Gene Expression*, Academic Press, New York, New York (1992), the entirety of which is herein incorporated by reference; Reid *et al.*, *Plant Physiol.* 93:160-165 (1990), the entirety of which is herein incorporated by reference; Ye *et al.*, *Plant J.* 1:175-183 (1991), the entirety of which is herein incorporated by reference).



It is understood that one or more of the molecules of the present invention, preferably one or more of the EST nucleic acid molecules or fragments thereof of the present invention or one or more of the antibodies of the present invention may be utilized to detect the presence or quantity of a carbon assimilation pathway enzyme by tissue printing.

Further it is also understood that any of the nucleic acid molecules of the present invention may be used as marker nucleic acids and or probes in connection with methods that require probes or marker nucleic acids. As used herein, a probe is an agent that is utilized to determine an attribute or feature (e.g. presence or absence, location, correlation, etc.) of a molecule, cell, tissue or plant. As used herein, a marker nucleic acid is a nucleic acid molecule that is utilized to determine an attribute or feature (e.g., presence or absence, location, correlation, etc.) or a molecule, cell, tissue or plant.

A microarray-based method for high-throughput monitoring of plant gene expression may be utilized to measure gene-specific hybridization targets. This 'chip'-based approach involves using microarrays of nucleic acid molecules as gene-specific hybridization targets to quantitatively measure expression of the corresponding plant genes (Schena *et al.*, *Science* 270:467-470 (1995), the entirety of which is herein incorporated by reference; Shalon, Ph.D. Thesis, Stanford University (1996), the entirety of which is herein incorporated by reference). Every nucleotide in a large sequence can be queried at the same time. Hybridization can be used to efficiently analyze nucleotide sequences.

Several microarray methods have been described. One method compares the sequences to be analyzed by hybridization to a set of oligonucleotides representing all possible subsequences (Bains and Smith, *J. Theor. Biol.* 135:303-307 (1989), the entirety of which is herein incorporated by reference). A second method hybridizes the sample to an array of

oligonucleotide or cDNA molecules. An array consisting of oligonucleotides complementary to subsequences of a target sequence can be used to determine the identity of a target sequence, measure its amount and detect differences between the target and a reference sequence. Nucleic acid molecules microarrays may also be screened with protein molecules or fragments thereof to determine nucleic acid molecules that specifically bind protein molecules or fragments thereof.

The microarray approach may be used with polypeptide targets (U.S. Patent No. 5,445,934; U.S. Patent No. 5,143,854; U.S. Patent No. 5,079,600; U.S. Patent No. 4,923,901, all of which are herein incorporated by reference in their entirety). Essentially, polypeptides are synthesized on a substrate (microarray) and these polypeptides can be screened with either protein molecules or fragments thereof or nucleic acid molecules in order to screen for either protein molecules or fragments thereof or nucleic acid molecules that specifically bind the target polypeptides. (Fodor *et al.*, *Science* 251:767-773 (1991), the entirety of which is herein incorporated by reference). It is understood that one or more of the nucleic acid molecules or protein or fragments thereof of the present invention may be utilized in a microarray based method.

In a preferred embodiment of the present invention microarrays may be prepared that comprise nucleic acid molecules where such nucleic acid molecules encode at least one, preferably at least two, more preferably at least three carbon assimilation pathway enzymes, more preferably at least four carbon assimilation pathway enzymes, more preferably at least five carbon assimilation pathway enzymes, more preferably at least six carbon assimilation pathway enzymes, more preferably at least seven carbon assimilation pathway enzymes, more preferably at least eight carbon assimilation pathway enzymes, more preferably at least nine carbon assimilation pathway enzymes, more preferably at least ten carbon assimilation pathway

enzymes, more preferably at least eleven carbon assimilation pathway enzymes, more preferably at least twelve carbon assimilation pathway enzymes, more preferably at least thirteen carbon assimilation pathway enzymes, more preferably at least fourteen carbon assimilation pathway enzymes, more preferably at least fifteen carbon assimilation pathway enzymes, more preferably at least sixteen carbon assimilation pathway enzymes, more preferably at least seventeen carbon assimilation pathway enzymes, more preferably at least eighteen carbon assimilation pathway enzymes, more preferably at least nineteen carbon assimilation pathway enzymes, more preferably at least twenty carbon assimilation pathway enzymes, more preferably at least twenty one carbon assimilation pathway enzymes, more preferably at least twenty two carbon assimilation pathway enzymes, more preferably at least twenty three carbon assimilation pathway enzymes, more preferably at least twenty four carbon assimilation pathway enzymes and even more preferably at least twenty five carbon assimilation pathway enzymes. In a preferred embodiment the nucleic acid molecules are selected from the group consisting of a nucleic acid molecule that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule

that encodes a putative maize or soybean transketolase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate kinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean alanine aminotransferase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or fragment thereof, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or fragment thereof and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or fragment thereof.

Site directed mutagenesis may be utilized to modify nucleic acid sequences, particularly as it is a technique that allows one or more of the amino acids encoded by a nucleic acid

molecule to be altered (e.g. a threonine to be replaced by a methionine). Three basic methods for site directed mutagenesis are often employed. These are cassette mutagenesis (Wells *et al.*, *Gene* 34:315-323 (1985), the entirety of which is herein incorporated by reference), primer extension (Gilliam *et al.*, *Gene* 12:129-137 (1980), the entirety of which is herein incorporated by reference; Zoller and Smith, *Methods Enzymol.* 100:468-500 (1983), the entirety of which is herein incorporated by reference; Dalbadie-McFarland *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 79:6409-6413 (1982), the entirety of which is herein incorporated by reference) and methods based upon PCR (Scharf *et al.*, *Science* 233:1076-1078 (1986), the entirety of which is herein incorporated by reference; Higuchi *et al.*, *Nucleic Acids Res.* 16:7351-7367 (1988), the entirety of which is herein incorporated by reference). Site directed mutagenesis approaches are also described in European Patent 0 385 962, the entirety of which is herein incorporated by reference; European Patent 0 359 472, the entirety of which is herein incorporated by reference; and PCT Patent Application WO 93/07278, the entirety of which is herein incorporated by reference.

Site directed mutagenesis strategies have been applied to plants for both *in vitro* as well as *in vivo* site directed mutagenesis (Lanz *et al.*, *J. Biol. Chem.* 266:9971-9976 (1991), the entirety of which is herein incorporated by reference; Kovgan and Zhdanov, *Biotekhnologiya* 5:148-154; No. 207160n, Chemical Abstracts 110:225 (1989), the entirety of which is herein incorporated by reference; Ge *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:4037-4041 (1989), the entirety of which is herein incorporated by reference; Zhu *et al.*, *J. Biol. Chem.* 271:18494-18498 (1996), the entirety of which is herein incorporated by reference; Chu *et al.*, *Biochemistry* 33:6150-6157 (1994), the entirety of which is herein incorporated by reference; Small *et al.*, *EMBO J.* 11:1291-1296 (1992), the entirety of which is herein incorporated by reference; Cho *et*

*al.*, *Mol. Biotechnol.* 8:13-16 (1997), the entirety of which is herein incorporated by reference; Kita *et al.*, *J. Biol. Chem.* 271:26529-26535 (1996), the entirety of which is herein incorporated by reference; Jin *et al.*, *Mol. Microbiol.* 7:555-562 (1993), the entirety of which is herein incorporated by reference; Hatfield and Vierstra, *J. Biol. Chem.* 267:14799-14803 (1992), the entirety of which is herein incorporated by reference; Zhao *et al.*, *Biochemistry* 31:5093-5099 (1992), the entirety of which is herein incorporated by reference).

Any of the nucleic acid molecules of the present invention may either be modified by site directed mutagenesis or used as, for example, nucleic acid molecules that are used to target other nucleic acid molecules for modification. It is understood that mutants with more than one altered nucleotide can be constructed using techniques that practitioners are familiar with such as isolating restriction fragments and ligating such fragments into an expression vector (*see*, for example, Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Press (1989)).

Sequence-specific DNA-binding proteins play a role in the regulation of transcription. The isolation of recombinant cDNAs encoding these proteins facilitates the biochemical analysis of their structural and functional properties. Genes encoding such DNA-binding proteins have been isolated using classical genetics (Vollbrecht *et al.*, *Nature* 350: 241-243 (1991), the entirety of which is herein incorporated by reference) and molecular biochemical approaches, including the screening of recombinant cDNA libraries with antibodies (Landschulz *et al.*, *Genes Dev.* 2:786-800 (1988), the entirety of which is herein incorporated by reference) or DNA probes (Bodner *et al.*, *Cell* 55:505-518 (1988), the entirety of which is herein incorporated by reference). In addition, an *in situ* screening procedure has been used and has facilitated the isolation of sequence-specific DNA-binding proteins from various plant species (Gilmartin *et al.*, *Plant Cell*

4:839-849 (1992), the entirety of which is herein incorporated by reference; Schindler *et al.*, *EMBO J.* 11:1261-1273 (1992), the entirety of which is herein incorporated by reference). An *in situ* screening protocol does not require the purification of the protein of interest (Vinson *et al.*, *Genes Dev.* 2:801-806 (1988), the entirety of which is herein incorporated by reference; Singh *et al.*, *Cell* 52:415-423 (1988), the entirety of which is herein incorporated by reference).

Two steps may be employed to characterize DNA-protein interactions. The first is to identify promoter fragments that interact with DNA-binding proteins, to titrate binding activity, to determine the specificity of binding and to determine whether a given DNA-binding activity can interact with related DNA sequences (Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, 2<sup>nd</sup> edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York (1989)). Electrophoretic mobility-shift assay is a widely used assay. The assay provides a rapid and sensitive method for detecting DNA-binding proteins based on the observation that the mobility of a DNA fragment through a nondenaturing, low-ionic strength polyacrylamide gel is retarded upon association with a DNA-binding protein (Fried and Crother, *Nucleic Acids Res.* 9:6505-6525 (1981), the entirety of which is herein incorporated by reference). When one or more specific binding activities have been identified, the exact sequence of the DNA bound by the protein may be determined. Several procedures for characterizing protein/DNA-binding sites are used, including methylation and ethylation interference assays (Maxam and Gilbert, *Methods Enzymol.* 65:499-560 (1980), the entirety of which is herein incorporated by reference; Wissman and Hillen, *Methods Enzymol.* 208:365-379 (1991), the entirety of which is herein incorporated by reference), footprinting techniques employing DNase I (Galas and Schmitz, *Nucleic Acids Res.* 5:3157-3170 (1978), the entirety of which is herein incorporated by reference), 1,10-

phenanthroline-copper ion methods (Sigman *et al.*, *Methods Enzymol.* 208:414-433 (1991), the entirety of which is herein incorporated by reference) and hydroxyl radicals methods (Dixon *et al.*, *Methods Enzymol.* 208:414-433 (1991), the entirety of which is herein incorporated by reference). It is understood that one or more of the nucleic acid molecules of the present invention may be utilized to identify a protein or fragment thereof that specifically binds to a nucleic acid molecule of the present invention. It is also understood that one or more of the protein molecules or fragments thereof of the present invention may be utilized to identify a nucleic acid molecule that specifically binds to it.

A two-hybrid system is based on the fact that many cellular functions are carried out by proteins, such as transcription factors, that interact (physically) with one another. Two-hybrid systems have been used to probe the function of new proteins (Chien *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 88:9578-9582 (1991) the entirety of which is herein incorporated by reference; Durfee *et al.*, *Genes Dev.* 7:555-569 (1993) the entirety of which is herein incorporated by reference; Choi *et al.*, *Cell* 78:499-512 (1994), the entirety of which is herein incorporated by reference; Kranz *et al.*, *Genes Dev.* 8:313-327 (1994), the entirety of which is herein incorporated by reference).

Interaction mating techniques have facilitated a number of two-hybrid studies of protein-protein interaction. Interaction mating has been used to examine interactions between small sets of tens of proteins (Finley and Brent, *Proc. Natl. Acad. Sci. (U.S.A.)* 91:12098-12984 (1994), the entirety of which is herein incorporated by reference), larger sets of hundreds of proteins (Bendixen *et al.*, *Nucl. Acids Res.* 22:1778-1779 (1994), the entirety of which is herein incorporated by reference) and to comprehensively map proteins encoded by a small genome (Bartel *et al.*, *Nature Genetics* 12:72-77 (1996), the entirety of which is herein incorporated by reference). This technique utilizes proteins fused to the DNA-binding domain and proteins fused



to the activation domain. They are expressed in two different haploid yeast strains of opposite mating type and the strains are mated to determine if the two proteins interact. Mating occurs when haploid yeast strains come into contact and result in the fusion of the two haploids into a diploid yeast strain. An interaction can be determined by the activation of a two-hybrid reporter gene in the diploid strain. An advantage of this technique is that it reduces the number of yeast transformations needed to test individual interactions. It is understood that the protein-protein interactions of protein or fragments thereof of the present invention may be investigated using the two-hybrid system and that any of the nucleic acid molecules of the present invention that encode such proteins or fragments thereof may be used to transform yeast in the two-hybrid system.

**(a) Plant Constructs and Plant Transformants**

One or more of the nucleic acid molecules of the present invention may be used in plant transformation or transfection. Exogenous genetic material may be transferred into a plant cell and the plant cell regenerated into a whole, fertile or sterile plant. Exogenous genetic material is any genetic material, whether naturally occurring or otherwise, from any source that is capable of being inserted into any organism. Such genetic material may be transferred into either monocotyledons and dicotyledons including, but not limited to maize (pp 63-69), soybean (pp 50-60), *Arabidopsis* (p 45), phaseolus (pp 47-49), peanut (pp 49-50), alfalfa (p 60), wheat (pp 69-71), rice (pp 72-79), oat (pp 80-81), sorghum (p 83), rye (p 84), tritordeum (p 84), millet (p85), fescue (p 85), perennial ryegrass (p 86), sugarcane (p87), cranberry (p101), papaya (pp 101-102), banana (p 103), banana (p 103), muskmelon (p 104), apple (p 104), cucumber (p 105), dendrobium (p 109), gladiolus (p 110), chrysanthemum (p 110), liliacea (p 111), cotton (pp113-114), eucalyptus (p 115), sunflower (p 118), canola (p 118), turfgrass (p121), sugarbeet (p 122),

coffee (p 122) and dioscorea (p 122), (Christou, In: *Particle Bombardment for Genetic Engineering of Plants*, Biotechnology Intelligence Unit. Academic Press, San Diego, California (1996), the entirety of which is herein incorporated by reference).

Transfer of a nucleic acid that encodes for a protein can result in overexpression of that protein in a transformed cell or transgenic plant. One or more of the proteins or fragments thereof encoded by nucleic acid molecules of the present invention may be overexpressed in a transformed cell or transformed plant. Particularly, any of the carbon assimilation pathway enzymes or fragments thereof may be overexpressed in a transformed cell or transgenic plant. Such overexpression may be the result of transient or stable transfer of the exogenous genetic material.

Exogenous genetic material may be transferred into a plant cell and the plant cell by the use of a DNA vector or construct designed for such a purpose. Design of such a vector is generally within the skill of the art (See, *Plant Molecular Biology: A Laboratory Manual*, Clark (ed.), Springer, New York (1997), the entirety of which is herein incorporated by reference).

A construct or vector may include a plant promoter to express the protein or protein fragment of choice. A number of promoters which are active in plant cells have been described in the literature. These include the nopaline synthase (NOS) promoter (Ebert *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 84:5745-5749 (1987), the entirety of which is herein incorporated by reference), the octopine synthase (OCS) promoter (which are carried on tumor-inducing plasmids of *Agrobacterium tumefaciens*), the caulimovirus promoters such as the cauliflower mosaic virus (CaMV) 19S promoter (Lawton *et al.*, *Plant Mol. Biol.* 9:315-324 (1987), the entirety of which is herein incorporated by reference) and the CAMV 35S promoter (Odell *et al.*, *Nature* 313:810-812 (1985), the entirety of which is herein incorporated by reference), the figwort mosaic virus

35S-promoter, the light-inducible promoter from the small subunit of ribulose-1,5-bis-phosphate carboxylase (ssRUBISCO), the Adh promoter (Walker *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 84:6624-6628 (1987), the entirety of which is herein incorporated by reference), the sucrose synthase promoter (Yang *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 87:4144-4148 (1990), the entirety of which is herein incorporated by reference), the R gene complex promoter (Chandler *et al.*, *The Plant Cell* 1:1175-1183 (1989), the entirety of which is herein incorporated by reference) and the chlorophyll a/b binding protein gene promoter, etc. These promoters have been used to create DNA constructs which have been expressed in plants; *see, e.g.*, PCT publication WO 84/02913, herein incorporated by reference in its entirety.

Promoters which are known or are found to cause transcription of DNA in plant cells can be used in the present invention. Such promoters may be obtained from a variety of sources such as plants and plant viruses. It is preferred that the particular promoter selected should be capable of causing sufficient expression to result in the production of an effective amount of the carbon assimilation pathway enzyme to cause the desired phenotype. In addition to promoters that are known to cause transcription of DNA in plant cells, other promoters may be identified for use in the current invention by screening a plant cDNA library for genes which are selectively or preferably expressed in the target tissues or cells.

For the purpose of expression in source tissues of the plant, such as the leaf, seed, root or stem, it is preferred that the promoters utilized in the present invention have relatively high expression in these specific tissues. For this purpose, one may choose from a number of promoters for genes with tissue- or cell-specific or -enhanced expression. Examples of such promoters reported in the literature include the chloroplast glutamine synthetase GS2 promoter from pea (Edwards *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 87:3459-3463 (1990), herein

incorporated by reference in its entirety), the chloroplast fructose-1,6-biphosphatase (FBPase) promoter from wheat (Lloyd *et al.*, *Mol. Gen. Genet.* 225:209-216 (1991), herein incorporated by reference in its entirety), the nuclear photosynthetic ST-LS1 promoter from potato (Stockhaus *et al.*, *EMBO J.* 8:2445-2451 (1989), herein incorporated by reference in its entirety), the serine/threonine kinase (PAL) promoter and the glucoamylase (CHS) promoter from *Arabidopsis thaliana*. Also reported to be active in photosynthetically active tissues are the ribulose-1,5-bisphosphate carboxylase (RbcS) promoter from eastern larch (*Larix laricina*), the promoter for the *cab* gene, *cab6*, from pine (Yamamoto *et al.*, *Plant Cell Physiol.* 35:773-778 (1994), herein incorporated by reference in its entirety), the promoter for the Cab-1 gene from wheat (Fejes *et al.*, *Plant Mol. Biol.* 15:921-932 (1990), herein incorporated by reference in its entirety), the promoter for the CAB-1 gene from spinach (Lubberstedt *et al.*, *Plant Physiol.* 104:997-1006 (1994), herein incorporated by reference in its entirety), the promoter for the *cab1R* gene from rice (Luan *et al.*, *Plant Cell.* 4:971-981 (1992), the entirety of which is herein incorporated by reference), the pyruvate, orthophosphate dikinase (PPDK) promoter from maize (Matsuoka *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 90: 9586-9590 (1993), herein incorporated by reference in its entirety), the promoter for the tobacco *Lhcb1\*2* gene (Cerdan *et al.*, *Plant Mol. Biol.* 33:245-255 (1997), herein incorporated by reference in its entirety), the *Arabidopsis thaliana* SUC2 sucrose-H<sup>+</sup> symporter promoter (Truernit *et al.*, *Planta.* 196:564-570 (1995), herein incorporated by reference in its entirety) and the promoter for the thylakoid membrane proteins from spinach (*psaD*, *psaF*, *psaE*, *PC*, *FNR*, *atpC*, *atpD*, *cab*, *rbcS*). Other promoters for the chlorophyll a/b-binding proteins may also be utilized in the present invention, such as the promoters for *LhcB* gene and *PsbP* gene from white mustard (*Sinapis alba*; Kretsch *et al.*, *Plant Mol. Biol.* 28:219-229 (1995), the entirety of which is herein incorporated by reference).

For the purpose of expression in sink tissues of the plant, such as the tuber of the potato plant, the fruit of tomato, or the seed of maize, wheat, rice and barley, it is preferred that the promoters utilized in the present invention have relatively high expression in these specific tissues. A number of promoters for genes with tuber-specific or -enhanced expression are known, including the class I patatin promoter (Bevan *et al.*, *EMBO J.* 8:1899-1906 (1986); Jefferson *et al.*, *Plant Mol. Biol.* 14:995-1006 (1990), both of which are herein incorporated by reference in its entirety), the promoter for the potato tuber ADPGPP genes, both the large and small subunits, the sucrose synthase promoter (Salanoubat and Belliard, *Gene.* 60:47-56 (1987), Salanoubat and Belliard, *Gene.* 84:181-185 (1989), both of which are incorporated by reference in their entirety), the promoter for the major tuber proteins including the 22 kd protein complexes and proteinase inhibitors (Hannapel, *Plant Physiol.* 101:703-704 (1993), herein incorporated by reference in its entirety), the promoter for the granule bound starch synthase gene (GBSS) (Visser *et al.*, *Plant Mol. Biol.* 17:691-699 (1991), herein incorporated by reference in its entirety) and other class I and II patatins promoters (Koster-Topfer *et al.*, *Mol Gen Genet.* 219:390-396 (1989); Mignery *et al.*, *Gene.* 62:27-44 (1988), both of which are herein incorporated by reference in their entirety).

Other promoters can also be used to express a carbon assimilation pathway enzyme or fragment thereof in specific tissues, such as seeds or fruits. The promoter for  $\beta$ -conglycinin (Chen *et al.*, *Dev. Genet.* 10: 112-122 (1989), herein incorporated by reference in its entirety) or other seed-specific promoters such as the napin and phaseolin promoters, can be used. The zeins are a group of storage proteins found in maize endosperm. Genomic clones for zein genes have been isolated (Pedersen *et al.*, *Cell* 29:1015-1026 (1982), herein incorporated by reference in its

entirety) and the promoters from these clones, including the 15 kD, 16 kD, 19 kD, 22 kD, 27 kD and genes, could also be used. Other promoters known to function, for example, in maize include the promoters for the following genes: *waxy*, *Brittle*, *Shrunken 2*, Branching enzymes I and II, starch synthases, debranching enzymes, oleosins, glutelins and sucrose synthases. A particularly preferred promoter for maize endosperm expression is the promoter for the glutelin gene from rice, more particularly the Osgt-1 promoter (Zheng *et al.*, *Mol. Cell Biol.* 13:5829-5842 (1993), herein incorporated by reference in its entirety). Examples of promoters suitable for expression in wheat include those promoters for the ADPGlucose pyrosynthase (ADPGPP) subunits, the granule bound and other starch synthase, the branching and debranching enzymes, the embryogenesis-abundant proteins, the gliadins and the glutenins. Examples of such promoters in rice include those promoters for the ADPGPP subunits, the granule bound and other starch synthase, the branching enzymes, the debranching enzymes, sucrose synthases and the glutelins. A particularly preferred promoter is the promoter for rice glutelin, Osgt-1. Examples of such promoters for barley include those for the ADPGPP subunits, the granule bound and other starch synthase, the branching enzymes, the debranching enzymes, sucrose synthases, the hordeins, the embryo globulins and the aleurone specific proteins.

Root specific promoters may also be used. An example of such a promoter is the promoter for the acid chitinase gene (Samac *et al.*, *Plant Mol. Biol.* 25:587-596 (1994), the entirety of which is herein incorporated by reference). Expression in root tissue could also be accomplished by utilizing the root specific subdomains of the CaMV35S promoter that have been identified (Lam *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:7890-7894 (1989), herein incorporated by reference in its entirety). Other root cell specific promoters include those

reported by Conkling *et al.* (Conkling *et al.*, *Plant Physiol.* 93:1203-1211 (1990), the entirety of which is herein incorporated by reference).

Additional promoters that may be utilized are described, for example, in U.S. Patent Nos. 5,378,619; 5,391,725; 5,428,147; 5,447,858; 5,608,144; 5,608,144; 5,614,399; 5,633,441; 5,633,435; and 4,633,436, all of which are herein incorporated in their entirety. In addition, a tissue specific enhancer may be used (Fromm *et al.*, *The Plant Cell* 1:977-984 (1989), the entirety of which is herein incorporated by reference).

Constructs or vectors may also include with the coding region of interest a nucleic acid sequence that acts, in whole or in part, to terminate transcription of that region. For example, such sequences have been isolated including the Tr7 3' sequence and the NOS 3' sequence (Ingelbrecht *et al.*, *The Plant Cell* 1:671-680 (1989), the entirety of which is herein incorporated by reference; Bevan *et al.*, *Nucleic Acids Res.* 11:369-385 (1983), the entirety of which is herein incorporated by reference), or the like.

A vector or construct may also include regulatory elements. Examples of such include the Adh intron 1 (Callis *et al.*, *Genes and Develop.* 1:1183-1200 (1987), the entirety of which is herein incorporated by reference), the sucrose synthase intron (Vasil *et al.*, *Plant Physiol.* 91:1575-1579 (1989), the entirety of which is herein incorporated by reference) and the TMV omega element (Gallie *et al.*, *The Plant Cell* 1:301-311 (1989), the entirety of which is herein incorporated by reference). These and other regulatory elements may be included when appropriate.

A vector or construct may also include a selectable marker. Selectable markers may also be used to select for plants or plant cells that contain the exogenous genetic material. Examples of such include, but are not limited to, a neo gene (Potrykus *et al.*, *Mol. Gen. Genet.* 199:183-188

(1985), the entirety of which is herein incorporated by reference) which codes for kanamycin resistance and can be selected for using kanamycin, G418, etc.; a bar gene which codes for bialaphos resistance; a mutant EPSP synthase gene (Hinchee *et al.*, *Bio/Technology* 6:915-922 (1988), the entirety of which is herein incorporated by reference) which encodes glyphosate resistance; a nitrilase gene which confers resistance to bromoxynil (Stalker *et al.*, *J. Biol. Chem.* 263:6310-6314 (1988), the entirety of which is herein incorporated by reference); a mutant acetolactate synthase gene (ALS) which confers imidazolinone or sulphonylurea resistance (European Patent Application 154,204 (Sept. 11, 1985), the entirety of which is herein incorporated by reference); and a methotrexate resistant DHFR gene (Thillet *et al.*, *J. Biol. Chem.* 263:12500-12508 (1988), the entirety of which is herein incorporated by reference).

A vector or construct may also include a transit peptide. Incorporation of a suitable chloroplast transit peptide may also be employed (European Patent Application Publication Number 0218571, the entirety of which is herein incorporated by reference). Translational enhancers may also be incorporated as part of the vector DNA. DNA constructs could contain one or more 5' non-translated leader sequences which may serve to enhance expression of the gene products from the resulting mRNA transcripts. Such sequences may be derived from the promoter selected to express the gene or can be specifically modified to increase translation of the mRNA. Such regions may also be obtained from viral RNAs, from suitable eukaryotic genes, or from a synthetic gene sequence. For a review of optimizing expression of transgenes, see Koziel *et al.*, *Plant Mol. Biol.* 32:393-405 (1996), the entirety of which is herein incorporated by reference.



A vector or construct may also include a screenable marker. Screenable markers may be used to monitor expression. Exemplary screenable markers include a  $\beta$ -glucuronidase or uidA gene (GUS) which encodes an enzyme for which various chromogenic substrates are known (Jefferson, *Plant Mol. Biol. Rep.* 5:387-405 (1987), the entirety of which is herein incorporated by reference; Jefferson *et al.*, *EMBO J.* 6:3901-3907 (1987), the entirety of which is herein incorporated by reference); an R-locus gene, which encodes a product that regulates the production of anthocyanin pigments (red color) in plant tissues (Dellaporta *et al.*, Stadler Symposium 11:263-282 (1988), the entirety of which is herein incorporated by reference); a  $\beta$ -lactamase gene (Sutcliffe *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 75:3737-3741 (1978), the entirety of which is herein incorporated by reference), a gene which encodes an enzyme for which various chromogenic substrates are known (e.g., PADAC, a chromogenic cephalosporin); a luciferase gene (Ow *et al.*, *Science* 234:856-859 (1986), the entirety of which is herein incorporated by reference); a xyle gene (Zukowsky *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 80:1101-1105 (1983), the entirety of which is herein incorporated by reference) which encodes a catechol dioxygenase that can convert chromogenic catechols; an  $\alpha$ -amylase gene (Ikata *et al.*, *Bio/Technol.* 8:241-242 (1990), the entirety of which is herein incorporated by reference); a tyrosinase gene (Katz *et al.*, *J. Gen. Microbiol.* 129:2703-2714 (1983), the entirety of which is herein incorporated by reference) which encodes an enzyme capable of oxidizing tyrosine to DOPA and dopaquinone which in turn condenses to melanin; an  $\alpha$ -galactosidase, which will turn a chromogenic  $\alpha$ -galactose substrate.

Included within the terms “selectable or screenable marker genes” are also genes which encode a secretable marker whose secretion can be detected as a means of identifying or

selecting for transformed cells. Examples include markers which encode a secretable antigen that can be identified by antibody interaction, or even secretable enzymes which can be detected catalytically. Secretable proteins fall into a number of classes, including small, diffusible proteins which are detectable, (*e.g.*, by ELISA), small active enzymes which are detectable in extracellular solution (*e.g.*,  $\alpha$ -amylase,  $\beta$ -lactamase, phosphinothricin transferase), or proteins which are inserted or trapped in the cell wall (such as proteins which include a leader sequence such as that found in the expression unit of extension or tobacco PR-S). Other possible selectable and/or screenable marker genes will be apparent to those of skill in the art.

There are many methods for introducing transforming nucleic acid molecules into plant cells. Suitable methods are believed to include virtually any method by which nucleic acid molecules may be introduced into a cell, such as by *Agrobacterium* infection or direct delivery of nucleic acid molecules such as, for example, by PEG-mediated transformation, by electroporation or by acceleration of DNA coated particles, etc (Potrykus, *Ann. Rev. Plant Physiol. Plant Mol. Biol.* 42:205-225 (1991), the entirety of which is herein incorporated by reference; Vasil, *Plant Mol. Biol.* 25:925-937 (1994), the entirety of which is herein incorporated by reference). For example, electroporation has been used to transform maize protoplasts (Fromm *et al.*, *Nature* 312:791-793 (1986), the entirety of which is herein incorporated by reference).

Other vector systems suitable for introducing transforming DNA into a host plant cell include but are not limited to binary artificial chromosome (BIBAC) vectors (Hamilton *et al.*, *Gene* 200:107-116 (1997), the entirety of which is herein incorporated by reference); and transfection with RNA viral vectors (Della-Cioppa *et al.*, *Ann. N.Y. Acad. Sci.* (1996), 792

(Engineering Plants for Commercial Products and Applications), 57-61, the entirety of which is herein incorporated by reference). Additional vector systems also include plant selectable YAC vectors such as those described in Mullen *et al.*, *Molecular Breeding* 4:449-457 (1988), the entirety of which is herein incorporated by reference).

Technology for introduction of DNA into cells is well known to those of skill in the art. Four general methods for delivering a gene into cells have been described: (1) chemical methods (Graham and van der Eb, *Virology* 54:536-539 (1973), the entirety of which is herein incorporated by reference); (2) physical methods such as microinjection (Capecchi, *Cell* 22:479-488 (1980), the entirety of which is herein incorporated by reference), electroporation (Wong and Neumann, *Biochem. Biophys. Res. Commun.* 107:584-587 (1982); Fromm *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 82:5824-5828 (1985); U.S. Patent No. 5,384,253, all of which are herein incorporated in their entirety); and the gene gun (Johnston and Tang, *Methods Cell Biol.* 43:353-365 (1994), the entirety of which is herein incorporated by reference); (3) viral vectors (Clapp, *Clin. Perinatol.* 20:155-168 (1993); Lu *et al.*, *J. Exp. Med.* 178:2089-2096 (1993); Eglitis and Anderson, *Biotechniques* 6:608-614 (1988), all of which are herein incorporated in their entirety); and (4) receptor-mediated mechanisms (Curiel *et al.*, *Hum. Gen. Ther.* 3:147-154 (1992), Wagner *et al.*, *Proc. Natl. Acad. Sci. (USA)* 89:6099-6103 (1992), both of which are incorporated by reference in their entirety).

Acceleration methods that may be used include, for example, microprojectile bombardment and the like. One example of a method for delivering transforming nucleic acid molecules to plant cells is microprojectile bombardment. This method has been reviewed by Yang and Christou (eds.), *Particle Bombardment Technology for Gene Transfer*, Oxford Press, Oxford, England (1994), the entirety of which is herein incorporated by reference). Non-

biological particles (microprojectiles) that may be coated with nucleic acids and delivered into cells by a propelling force. Exemplary particles include those comprised of tungsten, gold, platinum and the like.

A particular advantage of microprojectile bombardment, in addition to it being an effective means of reproducibly transforming monocots, is that neither the isolation of protoplasts (Cristou *et al.*, *Plant Physiol.* 87:671-674 (1988), the entirety of which is herein incorporated by reference) nor the susceptibility of *Agrobacterium* infection are required. An illustrative embodiment of a method for delivering DNA into maize cells by acceleration is a biolistics  $\alpha$ -particle delivery system, which can be used to propel particles coated with DNA through a screen, such as a stainless steel or Nytex screen, onto a filter surface covered with corn cells cultured in suspension. Gordon-Kamm *et al.*, describes the basic procedure for coating tungsten particles with DNA (Gordon-Kamm *et al.*, *Plant Cell* 2:603-618 (1990), the entirety of which is herein incorporated by reference). The screen disperses the tungsten nucleic acid particles so that they are not delivered to the recipient cells in large aggregates. A particle delivery system suitable for use with the present invention is the helium acceleration PDS-1000/He gun is available from Bio-Rad Laboratories (Bio-Rad, Hercules, California)(Sanford *et al.*, *Technique* 3:3-16 (1991), the entirety of which is herein incorporated by reference).

For the bombardment, cells in suspension may be concentrated on filters. Filters containing the cells to be bombarded are positioned at an appropriate distance below the microprojectile stopping plate. If desired, one or more screens are also positioned between the gun and the cells to be bombarded.

Alternatively, immature embryos or other target cells may be arranged on solid culture medium. The cells to be bombarded are positioned at an appropriate distance below the microprojectile stopping plate. If desired, one or more screens are also positioned between the acceleration device and the cells to be bombarded. Through the use of techniques set forth herein one may obtain up to 1000 or more foci of cells transiently expressing a marker gene. The number of cells in a focus which express the exogenous gene product 48 hours post-bombardment often range from one to ten and average one to three.

In bombardment transformation, one may optimize the pre-bombardment culturing conditions and the bombardment parameters to yield the maximum numbers of stable transformants. Both the physical and biological parameters for bombardment are important in this technology. Physical factors are those that involve manipulating the DNA/microprojectile precipitate or those that affect the flight and velocity of either the macro- or microprojectiles. Biological factors include all steps involved in manipulation of cells before and immediately after bombardment, the osmotic adjustment of target cells to help alleviate the trauma associated with bombardment and also the nature of the transforming DNA, such as linearized DNA or intact supercoiled plasmids. It is believed that pre-bombardment manipulations are especially important for successful transformation of immature embryos.

In another alternative embodiment, plastids can be stably transformed. Methods disclosed for plastid transformation in higher plants include the particle gun delivery of DNA containing a selectable marker and targeting of the DNA to the plastid genome through homologous recombination (Svab *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 87:8526-8530 (1990); Svab and Maliga, *Proc. Natl. Acad. Sci. (U.S.A.)* 90:913-917 (1993); Staub and Maliga, *EMBO*

J. 12:601-606 (1993); U.S. Patent Nos. 5, 451,513 and 5,545,818, all of which are herein incorporated by reference in their entirety).

Accordingly, it is contemplated that one may wish to adjust various aspects of the bombardment parameters in small scale studies to fully optimize the conditions. One may particularly wish to adjust physical parameters such as gap distance, flight distance, tissue distance and helium pressure. One may also minimize the trauma reduction factors by modifying conditions which influence the physiological state of the recipient cells and which may therefore influence transformation and integration efficiencies. For example, the osmotic state, tissue hydration and the subculture stage or cell cycle of the recipient cells may be adjusted for optimum transformation. The execution of other routine adjustments will be known to those of skill in the art in light of the present disclosure.

*Agrobacterium*-mediated transfer is a widely applicable system for introducing genes into plant cells because the DNA can be introduced into whole plant tissues, thereby bypassing the need for regeneration of an intact plant from a protoplast. The use of *Agrobacterium*-mediated plant integrating vectors to introduce DNA into plant cells is well known in the art. See, for example the methods described by Fraley *et al.*, *Bio/Technology* 3:629-635 (1985) and Rogers *et al.*, *Methods Enzymol.* 153:253-277 (1987), both of which are herein incorporated by reference in their entirety. Further, the integration of the Ti-DNA is a relatively precise process resulting in few rearrangements. The region of DNA to be transferred is defined by the border sequences and intervening DNA is usually inserted into the plant genome as described (Spielmann *et al.*, *Mol. Gen. Genet.* 205:34 (1986), the entirety of which is herein incorporated by reference).

Modern *Agrobacterium* transformation vectors are capable of replication in *E. coli* as well as *Agrobacterium*, allowing for convenient manipulations as described (Klee *et al.*, In: *Plant*

*DNA Infectious Agents*, Hohn and Schell (eds.), Springer-Verlag, New York, pp. 179-203 (1985), the entirety of which is herein incorporated by reference. Moreover, technological advances in vectors for *Agrobacterium*-mediated gene transfer have improved the arrangement of genes and restriction sites in the vectors to facilitate construction of vectors capable of expressing various polypeptide coding genes. The vectors described have convenient multi-linker regions flanked by a promoter and a polyadenylation site for direct expression of inserted polypeptide coding genes and are suitable for present purposes (Rogers *et al.*, *Methods Enzymol.* 153:253-277 (1987)). In addition, *Agrobacterium* containing both armed and disarmed Ti genes can be used for the transformations. In those plant strains where *Agrobacterium*-mediated transformation is efficient, it is the method of choice because of the facile and defined nature of the gene transfer.

A transgenic plant formed using *Agrobacterium* transformation methods typically contains a single gene on one chromosome. Such transgenic plants can be referred to as being heterozygous for the added gene. More preferred is a transgenic plant that is homozygous for the added structural gene; *i.e.*, a transgenic plant that contains two added genes, one gene at the same locus on each chromosome of a chromosome pair. A homozygous transgenic plant can be obtained by sexually mating (selfing) an independent segregant transgenic plant that contains a single added gene, germinating some of the seed produced and analyzing the resulting plants produced for the gene of interest.

It is also to be understood that two different transgenic plants can also be mated to produce offspring that contain two independently segregating added, exogenous genes. Selfing of appropriate progeny can produce plants that are homozygous for both added, exogenous genes that encode a polypeptide of interest. Back-crossing to a parental plant and out-crossing with a non-transgenic plant are also contemplated, as is vegetative propagation.

Transformation of plant protoplasts can be achieved using methods based on calcium phosphate precipitation, polyethylene glycol treatment, electroporation and combinations of these treatments (*See, for example, Potrykus et al., Mol. Gen. Genet. 205:193-200 (1986); Lorz et al., Mol. Gen. Genet. 199:178 (1985); Fromm et al., Nature 319:791 (1986); Uchimiya et al., Mol. Gen. Genet. 204:204 (1986); Marcotte et al., Nature 335:454-457 (1988)*, all of which are herein incorporated by reference in their entirety).

Application of these systems to different plant strains depends upon the ability to regenerate that particular plant strain from protoplasts. Illustrative methods for the regeneration of cereals from protoplasts are described (*Fujimura et al., Plant Tissue Culture Letters 2:74 (1985); Toriyama et al., Theor Appl. Genet. 205:34 (1986); Yamada et al., Plant Cell Rep. 4:85 (1986); Abdullah et al., Biotechnolog 4:1087 (1986)*, all of which are herein incorporated by reference in their entirety).

To transform plant strains that cannot be successfully regenerated from protoplasts, other ways to introduce DNA into intact cells or tissues can be utilized. For example, regeneration of cereals from immature embryos or explants can be effected as described (*Vasil, Biotechnology 6:397 (1988)*, the entirety of which is herein incorporated by reference). In addition, "particle gun" or high-velocity microprojectile technology can be utilized (*Vasil et al., Bio/Technology 10:667 (1992)*, the entirety of which is herein incorporated by reference).

Using the latter technology, DNA is carried through the cell wall and into the cytoplasm on the surface of small metal particles as described (*Klein et al., Nature 328:70 (1987); Klein et al., Proc. Natl. Acad. Sci. (U.S.A.) 85:8502-8505 (1988); McCabe et al., Bio/Technology 6:923 (1988)*, all of which are herein incorporated by reference in their entirety). The metal particles



penetrate through several layers of cells and thus allow the transformation of cells within tissue explants.

Other methods of cell transformation can also be used and include but are not limited to introduction of DNA into plants by direct DNA transfer into pollen (Zhou *et al.*, *Methods Enzymol.* 101:433 (1983); Hess *et al.*, *Intern Rev. Cytol.* 107:367 (1987); Luo *et al.*, *Plant Mol Biol. Reporter* 6:165 (1988), all of which are herein incorporated by reference in their entirety), by direct injection of DNA into reproductive organs of a plant (Pena *et al.*, *Nature* 325:274 (1987), the entirety of which is herein incorporated by reference), or by direct injection of DNA into the cells of immature embryos followed by the rehydration of desiccated embryos (Neuhaus *et al.*, *Theor. Appl. Genet.* 75:30 (1987), the entirety of which is herein incorporated by reference).

The regeneration, development and cultivation of plants from single plant protoplast transformants or from various transformed explants is well known in the art (Weissbach and Weissbach, In: *Methods for Plant Molecular Biology*, Academic Press, San Diego, CA, (1988), the entirety of which is herein incorporated by reference). This regeneration and growth process typically includes the steps of selection of transformed cells, culturing those individualized cells through the usual stages of embryonic development through the rooted plantlet stage. Transgenic embryos and seeds are similarly regenerated. The resulting transgenic rooted shoots are thereafter planted in an appropriate plant growth medium such as soil.

The development or regeneration of plants containing the foreign, exogenous gene that encodes a protein of interest is well known in the art. Preferably, the regenerated plants are self-pollinated to provide homozygous transgenic plants. Otherwise, pollen obtained from the regenerated plants is crossed to seed-grown plants of agronomically important lines. Conversely,

pollen from plants of these important lines is used to pollinate regenerated plants. A transgenic plant of the present invention containing a desired polypeptide is cultivated using methods well known to one skilled in the art.

There are a variety of methods for the regeneration of plants from plant tissue. The particular method of regeneration will depend on the starting plant tissue and the particular plant species to be regenerated.

Methods for transforming dicots, primarily by use of *Agrobacterium tumefaciens* and obtaining transgenic plants have been published for cotton (U.S. Patent No. 5,004,863; U.S. Patent No. 5,159,135; U.S. Patent No. 5,518,908, all of which are herein incorporated by reference in their entirety); soybean (U.S. Patent No. 5,569,834; U.S. Patent No. 5,416,011; McCabe *et. al.*, *Biotechnology* 6:923 (1988); Christou *et al.*, *Plant Physiol.* 87:671-674 (1988); all of which are herein incorporated by reference in their entirety); *Brassica* (U.S. Patent No. 5,463,174, the entirety of which is herein incorporated by reference); peanut (Cheng *et al.*, *Plant Cell Rep.* 15:653-657 (1996), McKently *et al.*, *Plant Cell Rep.* 14:699-703 (1995), all of which are herein incorporated by reference in their entirety); papaya; and pea (Grant *et al.*, *Plant Cell Rep.* 15:254-258 (1995), the entirety of which is herein incorporated by reference).

Transformation of monocotyledons using electroporation, particle bombardment and *Agrobacterium* have also been reported. Transformation and plant regeneration have been achieved in asparagus (Bytebier *et al.*, *Proc. Natl. Acad. Sci. (USA)* 84:5354 (1987), the entirety of which is herein incorporated by reference); barley (Wan and Lemaux, *Plant Physiol* 104:37 (1994), the entirety of which is herein incorporated by reference); maize (Rhodes *et al.*, *Science* 240:204 (1988); Gordon-Kamm *et al.*, *Plant Cell* 2:603-618 (1990); Fromm *et al.*, *Bio/Technology* 8:833 (1990); Koziel *et al.*, *Bio/Technology* 11:194 (1993); Armstrong *et al.*,

*Crop Science* 35:550-557 (1995); all of which are herein incorporated by reference in their entirety); oat (Somers *et al.*, *Bio/Technology* 10:1589 (1992), the entirety of which is herein incorporated by reference); orchard grass (Horn *et al.*, *Plant Cell Rep.* 7:469 (1988), the entirety of which is herein incorporated by reference); rice (Toriyama *et al.*, *Theor Appl. Genet.* 205:34 (1986); Part *et al.*, *Plant Mol. Biol.* 32:1135-1148 (1996); Abedinia *et al.*, *Aust. J. Plant Physiol.* 24:133-141 (1997); Zhang and Wu, *Theor. Appl. Genet.* 76:835 (1988); Zhang *et al.*, *Plant Cell Rep.* 7:379 (1988); Battraw and Hall, *Plant Sci.* 86:191-202 (1992); Christou *et al.*, *Bio/Technology* 9:957 (1991), all of which are herein incorporated by reference in their entirety); rye (De la Pena *et al.*, *Nature* 325:274 (1987), the entirety of which is herein incorporated by reference); sugarcane (Bower and Birch, *Plant J.* 2:409 (1992), the entirety of which is herein incorporated by reference); tall fescue (Wang *et al.*, *Bio/Technology* 10:691 (1992), the entirety of which is herein incorporated by reference) and wheat (Vasil *et al.*, *Bio/Technology* 10:667 (1992), the entirety of which is herein incorporated by reference; U.S. Patent No. 5,631,152, the entirety of which is herein incorporated by reference.)

Assays for gene expression based on the transient expression of cloned nucleic acid constructs have been developed by introducing the nucleic acid molecules into plant cells by polyethylene glycol treatment, electroporation, or particle bombardment (Marcotte *et al.*, *Nature* 335:454-457 (1988), the entirety of which is herein incorporated by reference; Marcotte *et al.*, *Plant Cell* 1:523-532 (1989), the entirety of which is herein incorporated by reference; McCarty *et al.*, *Cell* 66:895-905 (1991), the entirety of which is herein incorporated by reference; Hattori *et al.*, *Genes Dev.* 6:609-618 (1992), the entirety of which is herein incorporated by reference; Goff *et al.*, *EMBO J.* 9:2517-2522 (1990), the entirety of which is herein incorporated by reference). Transient expression systems may be used to functionally dissect gene constructs

(see generally, Mailga *et al.*, *Methods in Plant Molecular Biology*, Cold Spring Harbor Press (1995)).

Any of the nucleic acid molecules of the present invention may be introduced into a plant cell in a permanent or transient manner in combination with other genetic elements such as vectors, promoters, enhancers etc. Further, any of the nucleic acid molecules of the present invention may be introduced into a plant cell in a manner that allows for overexpression of the protein or fragment thereof encoded by the nucleic acid molecule.

Cosuppression is the reduction in expression levels, usually at the level of RNA, of a particular endogenous gene or gene family by the expression of a homologous sense construct that is capable of transcribing mRNA of the same strandedness as the transcript of the endogenous gene (Napoli *et al.*, *Plant Cell* 2:279-289 (1990), the entirety of which is herein incorporated by reference; van der Krol *et al.*, *Plant Cell* 2:291-299 (1990), the entirety of which is herein incorporated by reference). Cosuppression may result from stable transformation with a single copy nucleic acid molecule that is homologous to a nucleic acid sequence found with the cell (Prolls and Meyer, *Plant J.* 2:465-475 (1992), the entirety of which is herein incorporated by reference) or with multiple copies of a nucleic acid molecule that is homologous to a nucleic acid sequence found with the cell (Mittlesten *et al.*, *Mol. Gen. Genet.* 244:325-330 (1994), the entirety of which is herein incorporated by reference). Genes, even though different, linked to homologous promoters may result in the cosuppression of the linked genes (Vaucheret, *C.R. Acad. Sci. III* 316:1471-1483 (1993), the entirety of which is herein incorporated by reference).

This technique has, for example, been applied to generate white flowers from red petunia and tomatoes that do not ripen on the vine. Up to 50% of petunia transformants that contained a sense copy of the glucoamylase (CHS) gene produced white flowers or floral sectors; this was as

a result of the post-transcriptional loss of mRNA encoding CHS (Flavell, *Proc. Natl. Acad. Sci. (U.S.A.)* 91:3490-3496 (1994), the entirety of which is herein incorporated by reference); van Blokland *et al.*, *Plant J.* 6:861-877 (1994), the entirety of which is herein incorporated by reference). Cosuppression may require the coordinate transcription of the transgene and the endogenous gene and can be reset by a developmental control mechanism (Jorgensen, *Trends Biotechnol.* 8:340-344 (1990), the entirety of which is herein incorporated by reference; Meins and Kunz, In: *Gene Inactivation and Homologous Recombination in Plants*, Paszkowski (ed.), pp. 335-348, Kluwer Academic, Netherlands (1994), the entirety of which is herein incorporated by reference).

It is understood that one or more of the nucleic acids of the present invention may be introduced into a plant cell and transcribed using an appropriate promoter with such transcription resulting in the cosuppression of an endogenous carbon assimilation pathway enzyme.

Antisense approaches are a way of preventing or reducing gene function by targeting the genetic material (Mol *et al.*, *FEBS Lett.* 268:427-430 (1990), the entirety of which is herein incorporated by reference). The objective of the antisense approach is to use a sequence complementary to the target gene to block its expression and create a mutant cell line or organism in which the level of a single chosen protein is selectively reduced or abolished. Antisense techniques have several advantages over other 'reverse genetic' approaches. The site of inactivation and its developmental effect can be manipulated by the choice of promoter for antisense genes or by the timing of external application or microinjection. Antisense can manipulate its specificity by selecting either unique regions of the target gene or regions where it shares homology to other related genes (Hiatt *et al.*, In: *Genetic Engineering*, Setlow (ed.), Vol. 11, New York: Plenum 49-63 (1989), the entirety of which is herein incorporated by reference).

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The principle of regulation by antisense RNA is that RNA that is complementary to the target mRNA is introduced into cells, resulting in specific RNA:RNA duplexes being formed by base pairing between the antisense substrate and the target mRNA (Green *et al.*, *Annu. Rev. Biochem.* 55:569-597 (1986), the entirety of which is herein incorporated by reference). Under one embodiment, the process involves the introduction and expression of an antisense gene sequence. Such a sequence is one in which part or all of the normal gene sequences are placed under a promoter in inverted orientation so that the 'wrong' or complementary strand is transcribed into a noncoding antisense RNA that hybridizes with the target mRNA and interferes with its expression (Takayama and Inouye, *Crit. Rev. Biochem. Mol. Biol.* 25:155-184 (1990), the entirety of which is herein incorporated by reference). An antisense vector is constructed by standard procedures and introduced into cells by transformation, transfection, electroporation, microinjection, infection, etc. The type of transformation and choice of vector will determine whether expression is transient or stable. The promoter used for the antisense gene may influence the level, timing, tissue, specificity, or inducibility of the antisense inhibition.

It is understood that the activity of a carbon assimilation pathway enzyme in a plant cell may be reduced or depressed by growing a transformed plant cell containing a nucleic acid molecule whose non-transcribed strand encodes a carbon assimilation pathway enzyme or fragment thereof.

Antibodies have been expressed in plants (Hiatt *et al.*, *Nature* 342:76-78 (1989), the entirety of which is herein incorporated by reference; Conrad and Fielder, *Plant Mol. Biol.* 26:1023-1030 (1994), the entirety of which is herein incorporated by reference). Cytoplasmic expression of a scFv (single-chain Fv antibodies) has been reported to delay infection by artichoke mottled crinkle virus. Transgenic plants that express antibodies directed against

endogenous proteins may exhibit a physiological effect (Philips *et al.*, *EMBO J.* 16:4489-4496 (1997), the entirety of which is herein incorporated by reference; Marion-Poll, *Trends in Plant Science* 2:447-448 (1997), the entirety of which is herein incorporated by reference). For example, expressed anti-abscisic antibodies have been reported to result in a general perturbation of seed development (Philips *et al.*, *EMBO J.* 16: 4489-4496 (1997)).

Antibodies that are catalytic may also be expressed in plants (abzymes). The principle behind abzymes is that since antibodies may be raised against many molecules, this recognition ability can be directed toward generating antibodies that bind transition states to force a chemical reaction forward (Persidas, *Nature Biotechnology* 15:1313-1315 (1997), the entirety of which is herein incorporated by reference; Baca *et al.*, *Ann. Rev. Biophys. Biomol. Struct.* 26:461-493 (1997), the entirety of which is herein incorporated by reference). The catalytic abilities of abzymes may be enhanced by site directed mutagenesis. Examples of abzymes are, for example, set forth in U.S. Patent No. 5,658,753; U.S. Patent No. 5,632,990; U.S. Patent No. 5,631,137; U.S. Patent 5,602,015; U.S. Patent No. 5,559,538; U.S. Patent No. 5,576,174; U.S. Patent No. 5,500,358; U.S. Patent No. 5,318,897; U.S. Patent No. 5,298,409; U.S. Patent No. 5,258,289 and U.S. Patent No. 5,194,585, all of which are herein incorporated in their entirety.

It is understood that any of the antibodies of the present invention may be expressed in plants and that such expression can result in a physiological effect. It is also understood that any of the expressed antibodies may be catalytic.

#### **(b) Fungal Constructs and Fungal Transformants**

The present invention also relates to a fungal recombinant vector comprising exogenous genetic material. The present invention also relates to a fungal cell comprising a fungal

recombinant vector. The present invention also relates to methods for obtaining a recombinant fungal host cell comprising introducing into a fungal host cell exogenous genetic material.

Exogenous genetic material may be transferred into a fungal cell. In a preferred embodiment the exogenous genetic material includes a nucleic acid molecule of the present invention having a sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either or other nucleic acid molecule of the present invention. The fungal recombinant vector may be any vector which can be conveniently subjected to recombinant DNA procedures. The choice of a vector will typically depend on the compatibility of the vector with the fungal host cell into which the vector is to be introduced. The vector may be a linear or a closed circular plasmid. The vector system may be a single vector or plasmid or two or more vectors or plasmids which together contain the total DNA to be introduced into the genome of the fungal host.

The fungal vector may be an autonomously replicating vector, *i.e.*, a vector which exists as an extrachromosomal entity, the replication of which is independent of chromosomal replication, *e.g.*, a plasmid, an extrachromosomal element, a minichromosome, or an artificial chromosome. The vector may contain any means for assuring self-replication. Alternatively, the vector may be one which, when introduced into the fungal cell, is integrated into the genome and replicated together with the chromosome(s) into which it has been integrated. For integration, the vector may rely on the nucleic acid sequence of the vector for stable integration of the vector into the genome by homologous or nonhomologous recombination. Alternatively, the vector may contain additional nucleic acid sequences for directing integration by homologous recombination into the genome of the fungal host. The additional nucleic acid sequences enable the vector to be integrated into the host cell genome at a precise location(s) in the



chromosome(s). To increase the likelihood of integration at a precise location, there should be preferably two nucleic acid sequences which individually contain a sufficient number of nucleic acids, preferably 400bp to 1500bp, more preferably 800bp to 1000bp, which are highly homologous with the corresponding target sequence to enhance the probability of homologous recombination. These nucleic acid sequences may be any sequence that is homologous with a target sequence in the genome of the fungal host cell and, furthermore, may be non-encoding or encoding sequences.

For autonomous replication, the vector may further comprise an origin of replication enabling the vector to replicate autonomously in the host cell in question. Examples of origin of replications for use in a yeast host cell are the 2 micron origin of replication and the combination of CEN3 and ARS 1. Any origin of replication may be used which is compatible with the fungal host cell of choice.

The fungal vectors of the present invention preferably contain one or more selectable markers which permit easy selection of transformed cells. A selectable marker is a gene the product of which provides, for example biocide or viral resistance, resistance to heavy metals, prototrophy to auxotrophs and the like. The selectable marker may be selected from the group including, but not limited to, *amdS* (acetamidase), *argB* (ornithine carbamoyltransferase), *bar* (phosphinothricin acetyltransferase), *hygB* (hygromycin phosphotransferase), *niaD* (nitrate reductase), *pyrG* (orotidine-5'-phosphate decarboxylase) and *sC* (sulfate adenylyltransferase) and *trpC* (anthranilate synthase). Preferred for use in an *Aspergillus* cell are the *amdS* and *pyrG* markers of *Aspergillus nidulans* or *Aspergillus oryzae* and the *bar* marker of *Streptomyces hygroscopicus*. Furthermore, selection may be accomplished by co-transformation, *e.g.*, as described in WO 91/17243, the entirety of which is herein incorporated by reference. A nucleic

acid sequence of the present invention may be operably linked to a suitable promoter sequence. The promoter sequence is a nucleic acid sequence which is recognized by the fungal host cell for expression of the nucleic acid sequence. The promoter sequence contains transcription and translation control sequences which mediate the expression of the protein or fragment thereof.

A promoter may be any nucleic acid sequence which shows transcriptional activity in the fungal host cell of choice and may be obtained from genes encoding polypeptides either homologous or heterologous to the host cell. Examples of suitable promoters for directing the transcription of a nucleic acid construct of the invention in a filamentous fungal host are promoters obtained from the genes encoding *Aspergillus oryzae* TAKA amylase, *Rhizomucor miehei* aspartic proteinase, *Aspergillus niger* neutral alpha-amylase, *Aspergillus niger* acid stable alpha-amylase, *Aspergillus niger* or *Aspergillus awamori* glucoamylase (glaA), *Rhizomucor miehei* lipase, *Aspergillus oryzae* alkaline protease, *Aspergillus oryzae* triose phosphate isomerase, *Aspergillus nidulans* acetamidase and hybrids thereof. In a yeast host, a useful promoter is the *Saccharomyces cerevisiae* enolase (eno-1) promoter. Particularly preferred promoters are the TAKA amylase, NA2-tpi (a hybrid of the promoters from the genes encoding *Aspergillus niger* neutral alpha -amylase and *Aspergillus oryzae* triose phosphate isomerase) and glaA promoters.

A protein or fragment thereof encoding nucleic acid molecule of the present invention may also be operably linked to a terminator sequence at its 3' terminus. The terminator sequence may be native to the nucleic acid sequence encoding the protein or fragment thereof or may be obtained from foreign sources. Any terminator which is functional in the fungal host cell of choice may be used in the present invention, but particularly preferred terminators are obtained from the genes encoding *Aspergillus oryzae* TAKA amylase, *Aspergillus niger* glucoamylase,

*Aspergillus nidulans* anthranilate synthase, *Aspergillus niger* alpha-glucosidase and *Saccharomyces cerevisiae* enolase.

A protein or fragment thereof encoding nucleic acid molecule of the present invention may also be operably linked to a suitable leader sequence. A leader sequence is a nontranslated region of a mRNA which is important for translation by the fungal host. The leader sequence is operably linked to the 5' terminus of the nucleic acid sequence encoding the protein or fragment thereof. The leader sequence may be native to the nucleic acid sequence encoding the protein or fragment thereof or may be obtained from foreign sources. Any leader sequence which is functional in the fungal host cell of choice may be used in the present invention, but particularly preferred leaders are obtained from the genes encoding *Aspergillus oryzae* TAKA amylase and *Aspergillus oryzae* triose phosphate isomerase.

A polyadenylation sequence may also be operably linked to the 3' terminus of the nucleic acid sequence of the present invention. The polyadenylation sequence is a sequence which when transcribed is recognized by the fungal host to add polyadenosine residues to transcribed mRNA. The polyadenylation sequence may be native to the nucleic acid sequence encoding the protein or fragment thereof or may be obtained from foreign sources. Any polyadenylation sequence which is functional in the fungal host of choice may be used in the present invention, but particularly preferred polyadenylation sequences are obtained from the genes encoding *Aspergillus oryzae* TAKA amylase, *Aspergillus niger* glucoamylase, *Aspergillus nidulans* anthranilate synthase and *Aspergillus niger* alpha-glucosidase.

To avoid the necessity of disrupting the cell to obtain the protein or fragment thereof and to minimize the amount of possible degradation of the expressed protein or fragment thereof within the cell, it is preferred that expression of the protein or fragment thereof gives rise to a

product secreted outside the cell. To this end, a protein or fragment thereof of the present invention may be linked to a signal peptide linked to the amino terminus of the protein or fragment thereof. A signal peptide is an amino acid sequence which permits the secretion of the protein or fragment thereof from the fungal host into the culture medium. The signal peptide may be native to the protein or fragment thereof of the invention or may be obtained from foreign sources. The 5' end of the coding sequence of the nucleic acid sequence of the present invention may inherently contain a signal peptide coding region naturally linked in translation reading frame with the segment of the coding region which encodes the secreted protein or fragment thereof. Alternatively, the 5' end of the coding sequence may contain a signal peptide coding region which is foreign to that portion of the coding sequence which encodes the secreted protein or fragment thereof. The foreign signal peptide may be required where the coding sequence does not normally contain a signal peptide coding region. Alternatively, the foreign signal peptide may simply replace the natural signal peptide to obtain enhanced secretion of the desired protein or fragment thereof. The foreign signal peptide coding region may be obtained from a glucoamylase or an amylase gene from an *Aspergillus* species, a lipase or proteinase gene from *Rhizomucor miehei*, the gene for the alpha-factor from *Saccharomyces cerevisiae*, or the calf preprochymosin gene. An effective signal peptide for fungal host cells is the *Aspergillus oryzae* TAKA amylase signal, *Aspergillus niger* neutral amylase signal, the *Rhizomucor miehei* aspartic proteinase signal, the *Humicola lanuginosus* cellulase signal, or the *Rhizomucor miehei* lipase signal. However, any signal peptide capable of permitting secretion of the protein or fragment thereof in a fungal host of choice may be used in the present invention.

A protein or fragment thereof encoding nucleic acid molecule of the present invention may also be linked to a propeptide coding region. A propeptide is an amino acid sequence found

at the amino terminus of a proprotein or proenzyme. Cleavage of the propeptide from the proprotein yields a mature biochemically active protein. The resulting polypeptide is known as a polypeptide or proenzyme (or a zymogen in some cases). Polypeptides are generally inactive and can be converted to mature active polypeptides by catalytic or autocatalytic cleavage of the propeptide from the polypeptide or proenzyme. The propeptide coding region may be native to the protein or fragment thereof or may be obtained from foreign sources. The foreign propeptide coding region may be obtained from the *Saccharomyces cerevisiae* alpha-factor gene or *Myceliophthora thermophila* laccase gene (WO 95/33836, the entirety of which is herein incorporated by reference).

The procedures used to ligate the elements described above to construct the recombinant expression vector of the present invention are well known to one skilled in the art (see, for example, Sambrook *et al.*, *Molecular Cloning, A Laboratory Manual*, 2nd ed., Cold Spring Harbor, N.Y., (1989)).

The present invention also relates to recombinant fungal host cells produced by the methods of the present invention which are advantageously used with the recombinant vector of the present invention. The cell is preferably transformed with a vector comprising a nucleic acid sequence of the invention followed by integration of the vector into the host chromosome. The choice of fungal host cells will to a large extent depend upon the gene encoding the protein or fragment thereof and its source. The fungal host cell may, for example, be a yeast cell or a filamentous fungal cell.

"Yeast" as used herein includes *Ascosporogenous* yeast (*Endomycetales*), *Basidiosporogenous* yeast and yeast belonging to the *Fungi Imperfecti* (*Blastomycetes*). The *Ascosporogenous* yeasts are divided into the families *Spermophthoraceae* and

*Saccharomycetaceae*. The latter is comprised of four subfamilies, *Schizosaccharomycoideae* (for example, genus *Schizosaccharomyces*), *Nadsonioideae*, *Lipomycoideae* and *Saccharomycoideae* (for example, genera *Pichia*, *Kluyveromyces* and *Saccharomyces*). The *Basidiosporogenous* yeasts include the genera *Leucosporidium*, *Rhodospiridium*, *Sporidiobolus*, *Filobasidium* and *Filobasidiella*. Yeast belonging to the *Fungi Imperfecti* are divided into two families, *Sporobolomycetaceae* (for example, genera *Sorobolomyces* and *Bullera*) and *Cryptococcaceae* (for example, genus *Candida*). Since the classification of yeast may change in the future, for the purposes of this invention, yeast shall be defined as described in *Biology and Activities of Yeast* (Skinner *et al.*, *Soc. App. Bacteriol. Symposium Series* No. 9, (1980), the entirety of which is herein incorporated by reference). The biology of yeast and manipulation of yeast genetics are well known in the art (*see*, for example, *Biochemistry and Genetics of Yeast*, Bacil *et al.* (ed.), 2nd edition, 1987; *The Yeasts*, Rose and Harrison (eds.), 2nd ed., (1987); and *The Molecular Biology of the Yeast Saccharomyces*, Strathern *et al.* (eds.), (1981), all of which are herein incorporated by reference in their entirety).

"Fungi" as used herein includes the phyla *Ascomycota*, *Basidiomycota*, *Chytridiomycota* and *Zygomycota* (as defined by Hawksworth *et al.*, In: Ainsworth and Bisby's *Dictionary of The Fungi*, 8th edition, 1995, CAB International, University Press, Cambridge, UK; the entirety of which is herein incorporated by reference) as well as the *Oomycota* (as cited in Hawksworth *et al.*, In: Ainsworth and Bisby's *Dictionary of The Fungi*, 8th edition, 1995, CAB International, University Press, Cambridge, UK) and all mitosporic fungi (Hawksworth *et al.*, In: Ainsworth and Bisby's *Dictionary of The Fungi*, 8th edition, 1995, CAB International, University Press, Cambridge, UK). Representative groups of *Ascomycota* include, for example, *Neurospora*, *Eupenicillium* (= *Penicillium*), *Emericella* (= *Aspergillus*), *Eurotium* (= *Aspergillus*) and the true

yeasts listed above. Examples of *Basidiomycota* include mushrooms, rusts and smuts.

Representative groups of *Chytridiomycota* include, for example, *Allomyces*, *Blastocladiella*, *Coelomomyces* and aquatic fungi. Representative groups of *Oomycota* include, for example, *Saprolegniomycetous* aquatic fungi (water molds) such as *Achlya*. Examples of mitosporic fungi include *Aspergillus*, *Penicillium*, *Candida* and *Alternaria*. Representative groups of *Zygomycota* include, for example, *Rhizopus* and *Mucor*.

"Filamentous fungi" include all filamentous forms of the subdivision *Eumycota* and *Oomycota* (as defined by Hawksworth *et al.*, In: Ainsworth and Bisby's *Dictionary of The Fungi*, 8th edition, 1995, CAB International, University Press, Cambridge, UK). The filamentous fungi are characterized by a vegetative mycelium composed of chitin, cellulose, glucan, chitosan, mannan and other complex polysaccharides. Vegetative growth is by hyphal elongation and carbon catabolism is obligately aerobic. In contrast, vegetative growth by yeasts such as *Saccharomyces cerevisiae* is by budding of a unicellular thallus and carbon catabolism may be fermentative.

In one embodiment, the fungal host cell is a yeast cell. In a preferred embodiment, the yeast host cell is a cell of the species of *Candida*, *Kluyveromyces*, *Saccharomyces*, *Schizosaccharomyces*, *Pichia* and *Yarrowia*. In a preferred embodiment, the yeast host cell is a *Saccharomyces cerevisiae* cell, a *Saccharomyces carlsbergensis*, *Saccharomyces diastaticus* cell, a *Saccharomyces douglasii* cell, a *Saccharomyces kluyveri* cell, a *Saccharomyces norbensis* cell, or a *Saccharomyces oviformis* cell. In another preferred embodiment, the yeast host cell is a *Kluyveromyces lactis* cell. In another preferred embodiment, the yeast host cell is a *Yarrowia lipolytica* cell.

In another embodiment, the fungal host cell is a filamentous fungal cell. In a preferred embodiment, the filamentous fungal host cell is a cell of the species of, but not limited to, *Acremonium*, *Aspergillus*, *Fusarium*, *Humicola*, *Myceliophthora*, *Mucor*, *Neurospora*, *Penicillium*, *Thielavia*, *Tolypocladium* and *Trichoderma*. In a preferred embodiment, the filamentous fungal host cell is an *Aspergillus* cell. In another preferred embodiment, the filamentous fungal host cell is an *Acremonium* cell. In another preferred embodiment, the filamentous fungal host cell is a *Fusarium* cell. In another preferred embodiment, the filamentous fungal host cell is a *Humicola* cell. In another preferred embodiment, the filamentous fungal host cell is a *Myceliophthora* cell. In another even preferred embodiment, the filamentous fungal host cell is a *Mucor* cell. In another preferred embodiment, the filamentous fungal host cell is a *Neurospora* cell. In another preferred embodiment, the filamentous fungal host cell is a *Penicillium* cell. In another preferred embodiment, the filamentous fungal host cell is a *Thielavia* cell. In another preferred embodiment, the filamentous fungal host cell is a *Tolypocladium* cell. In another preferred embodiment, the filamentous fungal host cell is a *Trichoderma* cell. In a preferred embodiment, the filamentous fungal host cell is an *Aspergillus oryzae* cell, an *Aspergillus niger* cell, an *Aspergillus foetidus* cell, or an *Aspergillus japonicus* cell. In another preferred embodiment, the filamentous fungal host cell is a *Fusarium oxysporum* cell or a *Fusarium graminearum* cell. In another preferred embodiment, the filamentous fungal host cell is a *Humicola insolens* cell or a *Humicola lanuginosus* cell. In another preferred embodiment, the filamentous fungal host cell is a *Myceliophthora thermophila* cell. In a most preferred embodiment, the filamentous fungal host cell is a *Mucor miehei* cell. In a most preferred embodiment, the filamentous fungal host cell is a *Neurospora crassa* cell. In a most preferred embodiment, the filamentous fungal host cell is a *Penicillium purpurogenum* cell. In



another most preferred embodiment, the filamentous fungal host cell is a *Thielavia terrestris* cell. In another most preferred embodiment, the *Trichoderma* cell is a *Trichoderma reesei* cell, a *Trichoderma viride* cell, a *Trichoderma longibrachiatum* cell, a *Trichoderma harzianum* cell, or a *Trichoderma koningii* cell. In a preferred embodiment, the fungal host cell is selected from an *A. nidulans* cell, an *A. niger* cell, an *A. oryzae* cell and an *A. sojae* cell. In a further preferred embodiment, the fungal host cell is an *A. nidulans* cell.

The recombinant fungal host cells of the present invention may further comprise one or more sequences which encode one or more factors that are advantageous in the expression of the protein or fragment thereof, for example, an activator (e.g., a trans-acting factor), a chaperone and a processing protease. The nucleic acids encoding one or more of these factors are preferably not operably linked to the nucleic acid encoding the protein or fragment thereof. An activator is a protein which activates transcription of a nucleic acid sequence encoding a polypeptide (Kudla *et al.*, *EMBO* 9:1355-1364(1990); Jarai and Buxton, *Current Genetics* 26:2238-244(1994); Verdier, *Yeast* 6:271-297(1990), all of which are herein incorporated by reference in their entirety). The nucleic acid sequence encoding an activator may be obtained from the genes encoding *Saccharomyces cerevisiae* heme activator protein 1 (hap1), *Saccharomyces cerevisiae* galactose metabolizing protein 4 (gal4) and *Aspergillus nidulans* ammonia regulation protein (areA). For further examples, see Verdier, *Yeast* 6:271-297 (1990); MacKenzie *et al.*, *Journal of Gen. Microbiol.* 139:2295-2307 (1993), both of which are herein incorporated by reference in their entirety). A chaperone is a protein which assists another protein in folding properly (Hartl *et al.*, *TIBS* 19:20-25 (1994); Bergeron *et al.*, *TIBS* 19:124-128 (1994); Demolder *et al.*, *J. Biotechnology* 32:179-189 (1994); Craig, *Science* 260:1902-1903(1993); Gething and Sambrook, *Nature* 355:33-45 (1992); Puig and Gilbert, *J Biol. Chem.*

269:7764-7771 (1994); Wang and Tsou, *FASEB Journal* 7:1515-11157 (1993); Robinson *et al.*, *Bio/Technology* 1:381-384 (1994), all of which are herein incorporated by reference in their entirety). The nucleic acid sequence encoding a chaperone may be obtained from the genes encoding *Aspergillus oryzae* protein disulphide isomerase, *Saccharomyces cerevisiae* calnexin, *Saccharomyces cerevisiae* BiP/GRP78 and *Saccharomyces cerevisiae* Hsp70. For further examples, see Gething and Sambrook, *Nature* 355:33-45 (1992); Hartl *et al.*, *TIBS* 19:20-25 (1994). A processing protease is a protease that cleaves a propeptide to generate a mature biochemically active polypeptide (Enderlin and Ogrydziak, *Yeast* 10:67-79 (1994); Fuller *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 86:1434-1438 (1989); Julius *et al.*, *Cell* 37:1075-1089 (1984); Julius *et al.*, *Cell* 32:839-852 (1983), all of which are incorporated by reference in their entirety). The nucleic acid sequence encoding a processing protease may be obtained from the genes encoding *Aspergillus niger* Kex2, *Saccharomyces cerevisiae* dipeptidylaminopeptidase, *Saccharomyces cerevisiae* Kex2 and *Yarrowia lipolytica* dibasic processing endoprotease (xpr6). Any factor that is functional in the fungal host cell of choice may be used in the present invention.

Fungal cells may be transformed by a process involving protoplast formation, transformation of the protoplasts and regeneration of the cell wall in a manner known per se. Suitable procedures for transformation of *Aspergillus* host cells are described in EP 238 023 and Yelton *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 81:1470-1474 (1984), both of which are herein incorporated by reference in their entirety. A suitable method of transforming *Fusarium* species is described by Malardier *et al.*, *Gene* 78:147-156 (1989), the entirety of which is herein incorporated by reference. Yeast may be transformed using the procedures described by Becker and Guarente, In: Abelson and Simon, (eds.), *Guide to Yeast Genetics and Molecular Biology*,

*Methods Enzymol.* Volume 194, pp 182-187, Academic Press, Inc., New York; Ito *et al.*, *J. Bacteriology* 153:163 (1983); Hinnen *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 75:1920 (1978), all of which are herein incorporated by reference in their entirety.

The present invention also relates to methods of producing the protein or fragment thereof comprising culturing the recombinant fungal host cells under conditions conducive for expression of the protein or fragment thereof. The fungal cells of the present invention are cultivated in a nutrient medium suitable for production of the protein or fragment thereof using methods known in the art. For example, the cell may be cultivated by shake flask cultivation, small-scale or large-scale fermentation (including continuous, batch, fed-batch, or solid state fermentations) in laboratory or industrial fermentors performed in a suitable medium and under conditions allowing the protein or fragment thereof to be expressed and/or isolated. The cultivation takes place in a suitable nutrient medium comprising carbon and nitrogen sources and inorganic salts, using procedures known in the art (*see, e.g.*, Bennett and LaSure (eds.), *More Gene Manipulations in Fungi*, Academic Press, CA, (1991), the entirety of which is herein incorporated by reference). Suitable media are available from commercial suppliers or may be prepared according to published compositions (*e.g.*, in catalogues of the American Type Culture Collection, Manassas, VA). If the protein or fragment thereof is secreted into the nutrient medium, a protein or fragment thereof can be recovered directly from the medium. If the protein or fragment thereof is not secreted, it is recovered from cell lysates.

The expressed protein or fragment thereof may be detected using methods known in the art that are specific for the particular protein or fragment. These detection methods may include the use of specific antibodies, formation of an enzyme product, or disappearance of an enzyme substrate. For example, if the protein or fragment thereof has enzymatic activity, an enzyme

assay may be used. Alternatively, if polyclonal or monoclonal antibodies specific to the protein or fragment thereof are available, immunoassays may be employed using the antibodies to the protein or fragment thereof. The techniques of enzyme assay and immunoassay are well known to those skilled in the art.

The resulting protein or fragment thereof may be recovered by methods known in the arts. For example, the protein or fragment thereof may be recovered from the nutrient medium by conventional procedures including, but not limited to, centrifugation, filtration, extraction, spray-drying, evaporation, or precipitation. The recovered protein or fragment thereof may then be further purified by a variety of chromatographic procedures, e.g., ion exchange chromatography, gel filtration chromatography, affinity chromatography, or the like.

**(c) Mammalian Constructs and Transformed Mammalian Cells**

The present invention also relates to methods for obtaining a recombinant mammalian host cell, comprising introducing into a mammalian host cell exogenous genetic material. The present invention also relates to a mammalian cell comprising a mammalian recombinant vector. The present invention also relates to methods for obtaining a recombinant mammalian host cell, comprising introducing into a mammalian cell exogenous genetic material. In a preferred embodiment the exogenous genetic material includes a nucleic acid molecule of the present invention having a sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either or other nucleic acid molecule of the present invention.

Mammalian cell lines available as hosts for expression are known in the art and include many immortalized cell lines available from the American Type Culture Collection (ATCC, Manassas, VA), such as HeLa cells, Chinese hamster ovary (CHO) cells, baby hamster kidney

(BHK) cells and a number of other cell lines. Suitable promoters for mammalian cells are also known in the art and include viral promoters such as that from Simian Virus 40 (SV40) (Fiers *et al.*, *Nature* 273:113 (1978), the entirety of which is herein incorporated by reference), Rous sarcoma virus (RSV), adenovirus (ADV) and bovine papilloma virus (BPV). Mammalian cells may also require terminator sequences and poly-A addition sequences. Enhancer sequences which increase expression may also be included and sequences which promote amplification of the gene may also be desirable (for example methotrexate resistance genes).

Vectors suitable for replication in mammalian cells may include viral replicons, or sequences which insure integration of the appropriate sequences encoding HCV epitopes into the host genome. For example, another vector used to express foreign DNA is vaccinia virus. In this case, for example, a nucleic acid molecule encoding a protein or fragment thereof is inserted into the vaccinia genome. Techniques for the insertion of foreign DNA into the vaccinia virus genome are known in the art and may utilize, for example, homologous recombination. Such heterologous DNA is generally inserted into a gene which is non-essential to the virus, for example, the thymidine kinase gene (tk), which also provides a selectable marker. Plasmid vectors that greatly facilitate the construction of recombinant viruses have been described (*see*, for example, Mackett *et al.*, *J Virol.* 49:857 (1984); Chakrabarti *et al.*, *Mol. Cell. Biol.* 5:3403 (1985); Moss, In: *Gene Transfer Vectors For Mammalian Cells* (Miller and Calos, eds., Cold Spring Harbor Laboratory, N.Y., p. 10, (1987); all of which are herein incorporated by reference in their entirety). Expression of the HCV polypeptide then occurs in cells or animals which are infected with the live recombinant vaccinia virus.

The sequence to be integrated into the mammalian sequence may be introduced into the primary host by any convenient means, which includes calcium precipitated DNA, spheroplast

fusion, transformation, electroporation, biolistics, lipofection, microinjection, or other convenient means. Where an amplifiable gene is being employed, the amplifiable gene may serve as the selection marker for selecting hosts into which the amplifiable gene has been introduced.

Alternatively, one may include with the amplifiable gene another marker, such as a drug resistance marker, e.g. neomycin resistance (G418 in mammalian cells), hygromycin in resistance etc., or an auxotrophy marker (HIS3, TRP1, LEU2, URA3, ADE2, LYS2, etc.) for use in yeast cells.

Depending upon the nature of the modification and associated targeting construct, various techniques may be employed for identifying targeted integration. Conveniently, the DNA may be digested with one or more restriction enzymes and the fragments probed with an appropriate DNA fragment which will identify the properly sized restriction fragment associated with integration.

One may use different promoter sequences, enhancer sequences, or other sequence which will allow for enhanced levels of expression in the expression host. Thus, one may combine an enhancer from one source, a promoter region from another source, a 5'- noncoding region upstream from the initiation methionine from the same or different source as the other sequences and the like. One may provide for an intron in the non-coding region with appropriate splice sites or for an alternative 3'- untranslated sequence or polyadenylation site. Depending upon the particular purpose of the modification, any of these sequences may be introduced, as desired.

Where selection is intended, the sequence to be integrated will have with it a marker gene, which allows for selection. The marker gene may conveniently be downstream from the target gene and may include resistance to a cytotoxic agent, e.g. antibiotics, heavy metals, or the like, resistance or susceptibility to HAT, gancyclovir, etc., complementation to an auxotrophic

host, particularly by using an auxotrophic yeast as the host for the subject manipulations, or the like. The marker gene may also be on a separate DNA molecule, particularly with primary mammalian cells. Alternatively, one may screen the various transformants, due to the high efficiency of recombination in yeast, by using hybridization analysis, PCR, sequencing, or the like.

For homologous recombination, constructs can be prepared where the amplifiable gene will be flanked, normally on both sides with DNA homologous with the DNA of the target region. Depending upon the nature of the integrating DNA and the purpose of the integration, the homologous DNA will generally be within 100kb, usually 50kb, preferably about 25kb, of the transcribed region of the target gene, more preferably within 2kb of the target gene. Where modeling of the gene is intended, homology will usually be present proximal to the site of the mutation. The homologous DNA may include the 5'-upstream region outside of the transcriptional regulatory region or comprising any enhancer sequences, transcriptional initiation sequences, adjacent sequences, or the like. The homologous region may include a portion of the coding region, where the coding region may be comprised only of an open reading frame or combination of exons and introns. The homologous region may comprise all or a portion of an intron, where all or a portion of one or more exons may also be present. Alternatively, the homologous region may comprise the 3'-region, so as to comprise all or a portion of the transcriptional termination region, or the region 3' of this region. The homologous regions may extend over all or a portion of the target gene or be outside the target gene comprising all or a portion of the transcriptional regulatory regions and/or the structural gene.

The integrating constructs may be prepared in accordance with conventional ways, where sequences may be synthesized, isolated from natural sources, manipulated, cloned, ligated,

subjected to in vitro mutagenesis, primer repair, or the like. At various stages, the joined sequences may be cloned and analyzed by restriction analysis, sequencing, or the like. Usually during the preparation of a construct where various fragments are joined, the fragments, intermediate constructs and constructs will be carried on a cloning vector comprising a replication system functional in a prokaryotic host, e.g., *E. coli* and a marker for selection, e.g., biocide resistance, complementation to an auxotrophic host, etc. Other functional sequences may also be present, such as polylinkers, for ease of introduction and excision of the construct or portions thereof, or the like. A large number of cloning vectors are available such as pBR322, the pUC series, etc. These constructs may then be used for integration into the primary mammalian host.

In the case of the primary mammalian host, a replicating vector may be used. Usually, such vector will have a viral replication system, such as SV40, bovine papilloma virus, adenovirus, or the like. The linear DNA sequence vector may also have a selectable marker for identifying transfected cells. Selectable markers include the neo gene, allowing for selection with G418, the herpes tk gene for selection with HAT medium, the gpt gene with mycophenolic acid, complementation of an auxotrophic host, etc.

The vector may or may not be capable of stable maintenance in the host. Where the vector is capable of stable maintenance, the cells will be screened for homologous integration of the vector into the genome of the host, where various techniques for curing the cells may be employed. Where the vector is not capable of stable maintenance, for example, where a temperature sensitive replication system is employed, one may change the temperature from the permissive temperature to the non-permissive temperature, so that the cells may be cured of the



vector. In this case, only those cells having integration of the construct comprising the amplifiable gene and, when present, the selectable marker, will be able to survive selection.

Where a selectable marker is present, one may select for the presence of the targeting construct by means of the selectable marker. Where the selectable marker is not present, one may select for the presence of the construct by the amplifiable gene. For the neo gene or the herpes tk gene, one could employ a medium for growth of the transformants of about 0.1-1 mg/ml of G418 or may use HAT medium, respectively. Where DHFR is the amplifiable gene, the selective medium may include from about 0.01-0.5 M of methotrexate or be deficient in glycine-hypoxanthine-thymidine and have dialysed serum (GHT media).

The DNA can be introduced into the expression host by a variety of techniques that include calcium phosphate/DNA co-precipitates, microinjection of DNA into the nucleus, electroporation, yeast protoplast fusion with intact cells, transfection, polycations, e.g., polybrene, polyornithine, etc., or the like. The DNA may be single or double stranded DNA, linear or circular. The various techniques for transforming mammalian cells are well known (see Keown *et al.*, *Methods Enzymol.* (1989); Keown *et al.*, *Methods Enzymol.* 185:527-537 (1990); Mansour *et al.*, *Nature* 336:348-352, (1988); all of which are herein incorporated by reference in their entirety).

#### **(d) Insect Constructs and Transformed Insect Cells**

The present invention also relates to an insect recombinant vectors comprising exogenous genetic material. The present invention also relates to an insect cell comprising an insect recombinant vector. The present invention also relates to methods for obtaining a recombinant insect host cell, comprising introducing into an insect cell exogenous genetic material. In a preferred embodiment the exogenous genetic material includes a nucleic acid molecule of the

present invention having a sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either or other nucleic acid molecule of the present invention.

The insect recombinant vector may be any vector which can be conveniently subjected to recombinant DNA procedures and can bring about the expression of the nucleic acid sequence. The choice of a vector will typically depend on the compatibility of the vector with the insect host cell into which the vector is to be introduced. The vector may be a linear or a closed circular plasmid. The vector system may be a single vector or plasmid or two or more vectors or plasmids which together contain the total DNA to be introduced into the genome of the insect host. In addition, the insect vector may be an expression vector. Nucleic acid molecules can be suitably inserted into a replication vector for expression in the insect cell under a suitable promoter for insect cells. Many vectors are available for this purpose and selection of the appropriate vector will depend mainly on the size of the nucleic acid molecule to be inserted into the vector and the particular host cell to be transformed with the vector. Each vector contains various components depending on its function (amplification of DNA or expression of DNA) and the particular host cell with which it is compatible. The vector components for insect cell transformation generally include, but are not limited to, one or more of the following: a signal sequence, origin of replication, one or more marker genes and an inducible promoter.

The insect vector may be an autonomously replicating vector, *i.e.*, a vector which exists as an extrachromosomal entity, the replication of which is independent of chromosomal replication, *e.g.*, a plasmid, an extrachromosomal element, a minichromosome, or an artificial chromosome. The vector may contain any means for assuring self-replication. Alternatively, the vector may be one which, when introduced into the insect cell, is integrated into the genome and

replicated together with the chromosome(s) into which it has been integrated. For integration, the vector may rely on the nucleic acid sequence of the vector for stable integration of the vector into the genome by homologous or nonhomologous recombination. Alternatively, the vector may contain additional nucleic acid sequences for directing integration by homologous recombination into the genome of the insect host. The additional nucleic acid sequences enable the vector to be integrated into the host cell genome at a precise location(s) in the chromosome(s). To increase the likelihood of integration at a precise location, there should be preferably two nucleic acid sequences which individually contain a sufficient number of nucleic acids, preferably 400bp to 1500bp, more preferably 800bp to 1000bp, which are highly homologous with the corresponding target sequence to enhance the probability of homologous recombination. These nucleic acid sequences may be any sequence that is homologous with a target sequence in the genome of the insect host cell and, furthermore, may be non-encoding or encoding sequences.

Baculovirus expression vectors (BEVs) have become important tools for the expression of foreign genes, both for basic research and for the production of proteins with direct clinical applications in human and veterinary medicine (Doerfler, *Curr. Top. Microbiol. Immunol.* 131:51-68 (1968); Luckow and Summers, *Bio/Technology* 6:47-55 (1988a); Miller, *Annual Review of Microbiol.* 42:177-199 (1988); Summers, *Curr. Comm. Molecular Biology*, Cold Spring Harbor Press, Cold Spring Harbor, N.Y. (1988); all of which are herein incorporated by reference in their entirety). BEVs are recombinant insect viruses in which the coding sequence for a chosen foreign gene has been inserted behind a baculovirus promoter in place of the viral gene, e.g., polyhedrin (Smith and Summers, U.S. Pat. No., 4,745,051, the entirety of which is incorporated herein by reference).

The use of baculovirus vectors relies upon the host cells being derived from *Lepidopteran* insects such as *Spodoptera frugiperda* or *Trichoplusia ni*. The preferred *Spodoptera frugiperda* cell line is the cell line Sf9. The *Spodoptera frugiperda* Sf9 cell line was obtained from American Type Culture Collection (Manassas, VA.) and is assigned accession number ATCC CRL 1711 (Summers and Smith, *A Manual of Methods for Baculovirus Vectors and Insect Cell Culture Procedures*, Texas Ag. Exper. Station Bulletin No. 1555 (1988), the entirety of which is herein incorporated by reference). Other insect cell systems, such as the silkworm *B. mori* may also be used.

The proteins expressed by the BEVs are, therefore, synthesized, modified and transported in host cells derived from *Lepidopteran* insects. Most of the genes that have been inserted and produced in the baculovirus expression vector system have been derived from vertebrate species. Other baculovirus genes in addition to the polyhedrin promoter may be employed to advantage in a baculovirus expression system. These include immediate-early (alpha), delayed-early ( ), late ( ), or very late (delta), according to the phase of the viral infection during which they are expressed. The expression of these genes occurs sequentially, probably as the result of a "cascade" mechanism of transcriptional regulation. (Guarino and Summers, *J. Virol.* 57:563-571 (1986); Guarino and Summers, *J. Virol.* 61:2091-2099 (1987); Guarino and Summers, *Virol.* 162:444-451 (1988); all of which are herein incorporated by reference in their entirety).

Insect recombinant vectors are useful as intermediates for the infection or transformation of insect cell systems. For example, an insect recombinant vector containing a nucleic acid molecule encoding a baculovirus transcriptional promoter followed downstream by an insect signal DNA sequence is capable of directing the secretion of the desired biologically active protein from the insect cell. The vector may utilize a baculovirus transcriptional promoter region

derived from any of the over 500 baculoviruses generally infecting insects, such as for example the Orders *Lepidoptera*, *Diptera*, *Orthoptera*, *Coleoptera* and *Hymenoptera*, including for example but not limited to the viral DNAs of *Autographa californica* MNPV, *Bombyx mori* NPV, *Trichoplusia ni* MNPV, *Rachiplusia ou* MNPV or *Galleria mellonella* MNPV, wherein said baculovirus transcriptional promoter is a baculovirus immediate-early gene IEl or IEN promoter; an immediate-early gene in combination with a baculovirus delayed-early gene promoter region selected from the group consisting of 39K and a *HindIII*-*k* fragment delayed-early gene; or a baculovirus late gene promoter. The immediate-early or delayed-early promoters can be enhanced with transcriptional enhancer elements. The insect signal DNA sequence may code for a signal peptide of a *Lepidopteran* adipokinetic hormone precursor or a signal peptide of the *Manduca sexta* adipokinetic hormone precursor (Summers, U.S. Patent No. 5,155,037; the entirety of which is herein incorporated by reference). Other insect signal DNA sequences include a signal peptide of the *Orthoptera Schistocerca gregaria* locust adipokinetic hormone precursor and the *Drosophila melanogaster* cuticle genes CP1, CP2, CP3 or CP4 or for an insect signal peptide having substantially a similar chemical composition and function (Summers, U.S. Patent No. 5,155,037).

Insect cells are distinctly different from animal cells. Insects have a unique life cycle and have distinct cellular properties such as the lack of intracellular plasminogen activators in which are present in vertebrate cells. Another difference is the high expression levels of protein products ranging from 1 to greater than 500 mg/liter and the ease at which cDNA can be cloned into cells (Frasier, *In Vitro Cell. Dev. Biol.* 25:225 (1989); Summers and Smith, In: *A Manual of Methods for Baculovirus Vectors and Insect Cell Culture Procedures*, Texas Ag. Exper. Station Bulletin No. 1555 (1988), both of which are incorporated by reference in their entirety).

Recombinant protein expression in insect cells is achieved by viral infection or stable transformation. For viral infection, the desired gene is cloned into baculovirus at the site of the wild-type polyhedron gene (Webb and Summers, *Technique* 2:173 (1990); Bishop and Posse, *Adv. Gene Technol.* 1:55 (1990); both of which are incorporated by reference in their entirety). The polyhedron gene is a component of a protein coat in occlusions which encapsulate virus particles. Deletion or insertion in the polyhedron gene results the failure to form occlusion bodies. Occlusion negative viruses are morphologically different from occlusion positive viruses and enable one skilled in the art to identify and purify recombinant viruses.

The vectors of present invention preferably contain one or more selectable markers which permit easy selection of transformed cells. A selectable marker is a gene the product of which provides, for example biocide or viral resistance, resistance to heavy metals, prototrophy to auxotrophs and the like. Selection may be accomplished by co-transformation, *e.g.*, as described in WO 91/17243, a nucleic acid sequence of the present invention may be operably linked to a suitable promoter sequence. The promoter sequence is a nucleic acid sequence which is recognized by the insect host cell for expression of the nucleic acid sequence. The promoter sequence contains transcription and translation control sequences which mediate the expression of the protein or fragment thereof. The promoter may be any nucleic acid sequence which shows transcriptional activity in the insect host cell of choice and may be obtained from genes encoding polypeptides either homologous or heterologous to the host cell.

For example, a nucleic acid molecule encoding a protein or fragment thereof may also be operably linked to a suitable leader sequence. A leader sequence is a nontranslated region of a mRNA which is important for translation by the fungal host. The leader sequence is operably linked to the 5' terminus of the nucleic acid sequence encoding the protein or fragment thereof.

The leader sequence may be native to the nucleic acid sequence encoding the protein or fragment thereof or may be obtained from foreign sources. Any leader sequence which is functional in the insect host cell of choice may be used in the present invention.

A polyadenylation sequence may also be operably linked to the 3' terminus of the nucleic acid sequence of the present invention. The polyadenylation sequence is a sequence which when transcribed is recognized by the insect host to add polyadenosine residues to transcribed mRNA. The polyadenylation sequence may be native to the nucleic acid sequence encoding the protein or fragment thereof or may be obtained from foreign sources. Any polyadenylation sequence which is functional in the fungal host of choice may be used in the present invention.

To avoid the necessity of disrupting the cell to obtain the protein or fragment thereof and to minimize the amount of possible degradation of the expressed polypeptide within the cell, it is preferred that expression of the polypeptide gene gives rise to a product secreted outside the cell. To this end, the protein or fragment thereof of the present invention may be linked to a signal peptide linked to the amino terminus of the protein or fragment thereof. A signal peptide is an amino acid sequence which permits the secretion of the protein or fragment thereof from the insect host into the culture medium. The signal peptide may be native to the protein or fragment thereof of the invention or may be obtained from foreign sources. The 5' end of the coding sequence of the nucleic acid sequence of the present invention may inherently contain a signal peptide coding region naturally linked in translation reading frame with the segment of the coding region which encodes the secreted protein or fragment thereof.

At present, a mode of achieving secretion of a foreign gene product in insect cells is by way of the foreign gene's native signal peptide. Because the foreign genes are usually from non-insect organisms, their signal sequences may be poorly recognized by insect cells and hence,

levels of expression may be suboptimal. However, the efficiency of expression of foreign gene products seems to depend primarily on the characteristics of the foreign protein. On average, nuclear localized or non-structural proteins are most highly expressed, secreted proteins are intermediate and integral membrane proteins are the least expressed. One factor generally affecting the efficiency of the production of foreign gene products in a heterologous host system is the presence of native signal sequences (also termed presequences, targeting signals, or leader sequences) associated with the foreign gene. The signal sequence is generally coded by a DNA sequence immediately following (5' to 3') the translation start site of the desired foreign gene.

The expression dependence on the type of signal sequence associated with a gene product can be represented by the following example: If a foreign gene is inserted at a site downstream from the translational start site of the baculovirus polyhedrin gene so as to produce a fusion protein (containing the N-terminus of the polyhedrin structural gene), the fused gene is highly expressed. But less expression is achieved when a foreign gene is inserted in a baculovirus expression vector immediately following the transcriptional start site and totally replacing the polyhedrin structural gene.

Insertions into the region -50 to -1 significantly alter (reduce) steady state transcription which, in turn, reduces translation of the foreign gene product. Use of the pVL941 vector optimizes transcription of foreign genes to the level of the polyhedrin gene transcription. Even though the transcription of a foreign gene may be optimal, optimal translation may vary because of several factors involving processing: signal peptide recognition, mRNA and ribosome binding, glycosylation, disulfide bond formation, sugar processing, oligomerization, for example.

The properties of the insect signal peptide are expected to be more optimal for the efficiency of the translation process in insect cells than those from vertebrate proteins. This



phenomenon can generally be explained by the fact that proteins secreted from cells are synthesized as precursor molecules containing hydrophobic N-terminal signal peptides. The signal peptides direct transport of the select protein to its target membrane and are then cleaved by a peptidase on the membrane, such as the endoplasmic reticulum, when the protein passes through it.

Another exemplary insect signal sequence is the sequence encoding for *Drosophila* cuticle proteins such as CP1, CP2, CP3 or CP4 (Summers, U.S. Patent No. 5,278,050; the entirety of which is herein incorporated by reference). Most of a 9kb region of the *Drosophila* genome containing genes for the cuticle proteins has been sequenced. Four of the five cuticle genes contains a signal peptide coding sequence interrupted by a short intervening sequence (about 60 base pairs) at a conserved site. Conserved sequences occur in the 5' mRNA untranslated region, in the adjacent 35 base pairs of upstream flanking sequence and at -200 base pairs from the mRNA start position in each of the cuticle genes.

Standard methods of insect cell culture, cotransfection and preparation of plasmids are set forth in Summers and Smith (Summers and Smith, *A Manual of Methods for Baculovirus Vectors and Insect Cell Culture Procedures*, Texas Agricultural Experiment Station Bulletin No. 1555, Texas A&M University (1987)). Procedures for the cultivation of viruses and cells are described in Volkman and Summers, *J. Virol* 19:820-832 (1975) and Volkman *et al.*, *J. Virol* 19:820-832 (1976); both of which are herein incorporated by reference in their entirety.

**(e) Bacterial Constructs and Transformed Bacterial Cells**

The present invention also relates to a bacterial recombinant vector comprising exogenous genetic material. The present invention also relates to a bacteria cell comprising a bacterial recombinant vector. The present invention also relates to methods for obtaining a

recombinant bacteria host cell, comprising introducing into a bacterial host cell exogenous genetic material. . In a preferred embodiment the exogenous genetic material includes a nucleic acid molecule of the present invention having a sequence selected from the group consisting of SEQ ID NO: 1 through SEQ ID NO: 7341 or complements thereof or fragments of either or other nucleic acid molecule of the present invention.

The bacterial recombinant vector may be any vector which can be conveniently subjected to recombinant DNA procedures. The choice of a vector will typically depend on the compatibility of the vector with the bacterial host cell into which the vector is to be introduced. The vector may be a linear or a closed circular plasmid. The vector system may be a single vector or plasmid or two or more vectors or plasmids which together contain the total DNA to be introduced into the genome of the bacterial host. In addition, the bacterial vector may be an expression vector. Nucleic acid molecules encoding protein homologues or fragments thereof can, for example, be suitably inserted into a replicable vector for expression in the bacterium under the control of a suitable promoter for bacteria. Many vectors are available for this purpose and selection of the appropriate vector will depend mainly on the size of the nucleic acid to be inserted into the vector and the particular host cell to be transformed with the vector. Each vector contains various components depending on its function (amplification of DNA or expression of DNA) and the particular host cell with which it is compatible. The vector components for bacterial transformation generally include, but are not limited to, one or more of the following: a signal sequence, an origin of replication, one or more marker genes and an inducible promoter.

In general, plasmid vectors containing replicon and control sequences that are derived from species compatible with the host cell are used in connection with bacterial hosts. The

vector ordinarily carries a replication site, as well as marking sequences that are capable of providing phenotypic selection in transformed cells. For example, *E. coli* is typically transformed using pBR322, a plasmid derived from an *E. coli* species (see, e.g., Bolivar *et al.*, *Gene* 2:95 (1977); the entirety of which is herein incorporated by reference). pBR322 contains genes for ampicillin and tetracycline resistance and thus provides easy means for identifying transformed cells. The pBR322 plasmid, or other microbial plasmid or phage, also generally contains, or is modified to contain, promoters that can be used by the microbial organism for expression of the selectable marker genes.

Nucleic acid molecules encoding protein or fragments thereof may be expressed not only directly, but also as a fusion with another polypeptide, preferably a signal sequence or other polypeptide having a specific cleavage site at the N-terminus of the mature polypeptide. In general, the signal sequence may be a component of the vector, or it may be a part of the polypeptide DNA that is inserted into the vector. The heterologous signal sequence selected should be one that is recognized and processed (i.e., cleaved by a signal peptidase) by the host cell. For bacterial host cells that do not recognize and process the native polypeptide signal sequence, the signal sequence is substituted by a bacterial signal sequence selected, for example, from the group consisting of the alkaline phosphatase, penicillinase, lpp, or heat-stable enterotoxin II leaders.

Both expression and cloning vectors contain a nucleic acid sequence that enables the vector to replicate in one or more selected host cells. Generally, in cloning vectors this sequence is one that enables the vector to replicate independently of the host chromosomal DNA and includes origins of replication or autonomously replicating sequences. Such sequences are well

known for a variety of bacteria. The origin of replication from the plasmid pBR322 is suitable for most Gram-negative bacteria.

Expression and cloning vectors also generally contain a selection gene, also termed a selectable marker. This gene encodes a protein necessary for the survival or growth of transformed host cells grown in a selective culture medium. Host cells not transformed with the vector containing the selection gene will not survive in the culture medium. Typical selection genes encode proteins that (a) confer resistance to antibiotics or other toxins, e.g., ampicillin, neomycin, methotrexate, or tetracycline, (b) complement auxotrophic deficiencies, or (c) supply critical nutrients not available from complex media, e.g., the gene encoding D-alanine racemase for *Bacilli*. One example of a selection scheme utilizes a drug to arrest growth of a host cell. Those cells that are successfully transformed with a heterologous protein homologue or fragment thereof produce a protein conferring drug resistance and thus survive the selection regimen.

The expression vector for producing a protein or fragment thereof can also contain an inducible promoter that is recognized by the host bacterial organism and is operably linked to the nucleic acid encoding, for example, the nucleic acid molecule encoding the protein homologue or fragment thereof of interest. Inducible promoters suitable for use with bacterial hosts include the -lactamase and lactose promoter systems (Chang *et al.*, *Nature* 275:615 (1978); Goeddel *et al.*, *Nature* 281:544 (1979); both of which are herein incorporated by reference in their entirety), the arabinose promoter system (Guzman *et al.*, *J. Bacteriol.* 174:7716-7728 (1992); the entirety of which is herein incorporated by reference), alkaline phosphatase, a tryptophan (trp) promoter system (Goeddel, *Nucleic Acids Res.* 8:4057 (1980); EP 36,776; both of which are herein incorporated by reference in their entirety) and hybrid promoters such as the tac promoter (deBoer *et al.*, *Proc. Natl. Acad. Sci. (USA)* 80:21-25 (1983); the entirety of which is herein

incorporated by reference). However, other known bacterial inducible promoters are suitable (Siebenlist *et al.*, *Cell* 20:269 (1980); the entirety of which is herein incorporated by reference).

Promoters for use in bacterial systems also generally contain a Shine-Dalgarno (S.D.) sequence operably linked to the DNA encoding the polypeptide of interest. The promoter can be removed from the bacterial source DNA by restriction enzyme digestion and inserted into the vector containing the desired DNA.

Construction of suitable vectors containing one or more of the above-listed components employs standard ligation techniques. Isolated plasmids or DNA fragments are cleaved, tailored and re-ligated in the form desired to generate the plasmids required. Examples of available bacterial expression vectors include, but are not limited to, the multifunctional *E. coli* cloning and expression vectors such as Bluescript™ (Stratagene, La Jolla, CA), in which, for example, encoding an *A. nidulans* protein homologue or fragment thereof homologue, may be ligated into the vector in frame with sequences for the amino-terminal Met and the subsequent 7 residues of -galactosidase so that a hybrid protein is produced; pIN vectors (Van Heeke and Schuster, *J. Biol. Chem.* 264:5503-5509 (1989), the entirety of which is herein incorporated by reference); and the like. pGEX vectors (Promega, Madison Wisconsin U.S.A.) may also be used to express foreign polypeptides as fusion proteins with glutathione S-transferase (GST). In general, such fusion proteins are soluble and can easily be purified from lysed cells by adsorption to glutathione-agarose beads followed by elution in the presence of free glutathione. Proteins made in such systems are designed to include heparin, thrombin or factor XA protease cleavage sites so that the cloned polypeptide of interest can be released from the GST moiety at will.

Suitable host bacteria for a bacterial vector include archaebacteria and eubacteria, especially eubacteria and most preferably *Enterobacteriaceae*. Examples of useful bacteria include *Escherichia*, *Enterobacter*, *Azotobacter*, *Erwinia*, *Bacillus*, *Pseudomonas*, *Klebsiella*, *Proteus*, *Salmonella*, *Serratia*, *Shigella*, *Rhizobia*, *Vitreoscilla* and *Paracoccus*. Suitable *E. coli* hosts include *E. coli* W3110 (American Type Culture Collection (ATCC) 27,325, Manassas, Virginia U.S.A.), *E. coli* 294 (ATCC 31,446), *E. coli* B and *E. coli* X1776 (ATCC 31,537). These examples are illustrative rather than limiting. Mutant cells of any of the above-mentioned bacteria may also be employed. It is, of course, necessary to select the appropriate bacteria taking into consideration replicability of the replicon in the cells of a bacterium. For example, *E. coli*, *Serratia*, or *Salmonella* species can be suitably used as the host when well known plasmids such as pBR322, pBR325, pACYC177, or pKN410 are used to supply the replicon. *E. coli* strain W3110 is a preferred host or parent host because it is a common host strain for recombinant DNA product fermentations. Preferably, the host cell should secrete minimal amounts of proteolytic enzymes.

Host cells are transfected and preferably transformed with the above-described vectors and cultured in conventional nutrient media modified as appropriate for inducing promoters, selecting transformants, or amplifying the genes encoding the desired sequences.

Numerous methods of transfection are known to the ordinarily skilled artisan, for example, calcium phosphate and electroporation. Depending on the host cell used, transformation is done using standard techniques appropriate to such cells. The calcium treatment employing calcium chloride, as described in section 1.82 of Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, New York: Cold Spring Harbor Laboratory Press, (1989), is generally used for bacterial cells that contain substantial cell-wall barriers. Another

method for transformation employs polyethylene glycol/DMSO, as described in Chung and Miller (Chung and Miller, *Nucleic Acids Res.* 16:3580 (1988); the entirety of which is herein incorporated by reference). Yet another method is the use of the technique termed electroporation.

Bacterial cells used to produce the polypeptide of interest for purposes of this invention are cultured in suitable media in which the promoters for the nucleic acid encoding the heterologous polypeptide can be artificially induced as described generally, e.g., in Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, New York: Cold Spring Harbor Laboratory Press, (1989). Examples of suitable media are given in U.S. Pat. Nos. 5,304,472 and 5,342,763; both of which are incorporated by reference in their entirety.

In addition to the above discussed procedures, practitioners are familiar with the standard resource materials which describe specific conditions and procedures for the construction, manipulation and isolation of macromolecules (e.g., DNA molecules, plasmids, etc.), generation of recombinant organisms and the screening and isolating of clones, (see for example, Sambrook *et al.*, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Press (1989); Mailga *et al.*, *Methods in Plant Molecular Biology*, Cold Spring Harbor Press (1995), the entirety of which is herein incorporated by reference; Birren *et al.*, *Genome Analysis: Analyzing DNA*, 1, Cold Spring Harbor, New York, the entirety of which is herein incorporated by reference).

**(f) Computer Readable Media**

The nucleotide sequence provided in SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof, or complement thereof, or a nucleotide sequence at least 90% identical, preferably 95%, identical even more preferably 99% or 100% identical to the sequence provided in SEQ ID NO: 1 through SEQ ID NO: 7341 or fragment thereof, or complement thereof, can be

“provided” in a variety of mediums to facilitate use. Such a medium can also provide a subset thereof in a form that allows a skilled artisan to examine the sequences.

A preferred subset of nucleotide sequences are those nucleic acid sequences that encode a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encode a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate



kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean aspartate aminotransferase enzyme or complement thereof or fragment of either, nucleic acid sequences that encode a maize or soybean alanine aminotransferase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NAD-dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative soybean PEP carboxykinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or complement thereof or fragment of either and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof or fragment of either.

A further preferred subset of nucleic acid sequences is where the subset of sequences which encode two proteins or fragments thereof, more preferably three proteins or fragments thereof, more preferable four proteins or fragments thereof, more preferably five proteins or fragments thereof, more preferable six proteins or fragments thereof, more preferably seven proteins or fragments thereof, more preferably eight proteins or fragments thereof, more preferable nine proteins or fragments thereof, more preferably ten proteins or fragments thereof,

more preferably eleven proteins or fragments thereof, more preferable twelve proteins or fragments thereof, more preferably thirteen proteins or fragments thereof, more preferably fourteen proteins or fragments thereof, more preferable fifteen proteins or fragments thereof, more preferably sixteen proteins or fragments thereof, more preferably seventeen proteins or fragments thereof, more preferable eighteen proteins or fragments thereof, more preferably nineteen proteins or fragments thereof, more preferably twenty proteins or fragments thereof. more preferably twenty one proteins or fragments thereof, more preferable twenty two proteins or fragments thereof, more preferably twenty three proteins or fragments thereof, more preferably twenty four proteins or fragments thereof, and even more preferably twenty five proteins or fragments thereof. These nucleic acid sequences are selected from the group that encodes a maize or soybean ribulose-bisphosphate carboxylase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean phosphoglycerate kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize glyceraldehyde 3-phosphate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean triose phosphate isomerase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean aldolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean fructose-1,6-bisphosphatase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean transketolase enzyme or complement thereof or fragment of either, a nucleic acid

molecule that encode a maize or soybean sedoheptulose-1,7-bisphosphatase enzyme or  
 complement thereof or fragment of either, a nucleic acid molecule that encodes a maize or  
 soybean D-ribulose-5-phosphate-3-epimerase enzyme or complement thereof or fragment of  
 either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate isomerase  
 enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a  
 putative maize or soybean ribose-5-phosphate isomerase enzyme or complement thereof or  
 fragment of either, a nucleic acid molecule that encodes a maize or soybean ribose-5-phosphate  
 kinase enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes  
 a maize or soybean phosphoenolpyruvate carboxylase enzyme or complement thereof or  
 fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-dependent  
 malate dehydrogenase enzyme or complement thereof or fragment of either, a nucleic acid  
 molecule that encodes a maize or soybean aspartate aminotransferase enzyme or complement  
 thereof or fragment of either, a nucleic acid molecule that encodes a putative maize or soybean  
 aspartate aminotransferase enzyme or complement thereof or fragment of either, nucleic acid  
 sequences that encode a maize or soybean alanine aminotransferase enzyme or complement  
 thereof or fragment of either, a nucleic acid molecule that encodes a maize or soybean NADP-  
 dependent malic enzyme or complement thereof or fragment of either, a nucleic acid molecule  
 that encodes a maize or soybean NAD-dependent malic enzyme or complement thereof or  
 fragment of either, a nucleic acid molecule that encodes a maize or soybean PEP carboxykinase  
 enzyme or complement thereof or fragment of either, a nucleic acid molecule that encodes a  
 putative soybean PEP carboxykinase enzyme or complement thereof or fragment either, a nucleic  
 acid molecule that encodes a maize or soybean pyruvate, phosphate dikinase enzyme or

complement thereof or fragment of either and a nucleic acid molecule that encodes a maize or soybean pyrophosphatase enzyme or complement thereof or fragment of either.

In one application of this embodiment, a nucleotide sequence of the present invention can be recorded on computer readable media. As used herein, "computer readable media" refers to any medium that can be read and accessed directly by a computer. Such media include, but are not limited to: magnetic storage media, such as floppy discs, hard disc, storage medium and magnetic tape; optical storage media such as CD-ROM; electrical storage media such as RAM and ROM; and hybrids of these categories such as magnetic/optical storage media. A skilled artisan can readily appreciate how any of the presently known computer readable mediums can be used to create a manufacture comprising computer readable medium having recorded thereon a nucleotide sequence of the present invention.

As used herein, "recorded" refers to a process for storing information on computer readable medium. A skilled artisan can readily adopt any of the presently known methods for recording information on computer readable medium to generate media comprising the nucleotide sequence information of the present invention. A variety of data storage structures are available to a skilled artisan for creating a computer readable medium having recorded thereon a nucleotide sequence of the present invention. The choice of the data storage structure will generally be based on the means chosen to access the stored information. In addition, a variety of data processor programs and formats can be used to store the nucleotide sequence information of the present invention on computer readable medium. The sequence information can be represented in a word processing text file, formatted in commercially-available software such as WordPerfect and Microsoft Word, or represented in the form of an ASCII file, stored in a database application, such as DB2, Sybase, Oracle, or the like. A skilled artisan can readily

adapt any number of data processor structuring formats (e.g. text file or database) in order to obtain computer readable medium having recorded thereon the nucleotide sequence information of the present invention.

By providing one or more of nucleotide sequences of the present invention, a skilled artisan can routinely access the sequence information for a variety of purposes. Computer software is publicly available which allows a skilled artisan to access sequence information provided in a computer readable medium. The examples which follow demonstrate how software which implements the BLAST (Altschul *et al.*, *J. Mol. Biol.* 215:403-410 (1990), the entirety of which is herein incorporated by reference) and BLAZE (Brutlag *et al.*, *Comp. Chem.* 17:203-207 (1993), the entirety of which is herein incorporated by reference) search algorithms on a Sybase system can be used to identify open reading frames (ORFs) within the genome that contain homology to ORFs or proteins from other organisms. Such ORFs are protein-encoding fragments within the sequences of the present invention and are useful in producing commercially important proteins such as enzymes used in amino acid biosynthesis, metabolism, transcription, translation, RNA processing, nucleic acid and a protein degradation, protein modification and DNA replication, restriction, modification, recombination and repair.

The present invention further provides systems, particularly computer-based systems, which contain the sequence information described herein. Such systems are designed to identify commercially important fragments of the nucleic acid molecule of the present invention. As used herein, "a computer-based system" refers to the hardware means, software means and data storage means used to analyze the nucleotide sequence information of the present invention. The minimum hardware means of the computer-based systems of the present invention comprises a central processing unit (CPU), input means, output means and data storage means. A skilled

artisan can readily appreciate that any one of the currently available computer-based system are suitable for use in the present invention.

As indicated above, the computer-based systems of the present invention comprise a data storage means having stored therein a nucleotide sequence of the present invention and the necessary hardware means and software means for supporting and implementing a search means. As used herein, "data storage means" refers to memory that can store nucleotide sequence information of the present invention, or a memory access means which can access manufactures having recorded thereon the nucleotide sequence information of the present invention. As used herein, "search means" refers to one or more programs which are implemented on the computer-based system to compare a target sequence or target structural motif with the sequence information stored within the data storage means. Search means are used to identify fragments or regions of the sequence of the present invention that match a particular target sequence or target motif. A variety of known algorithms are disclosed publicly and a variety of commercially available software for conducting search means are available can be used in the computer-based systems of the present invention. Examples of such software include, but are not limited to, MacPattern (EMBL), BLASTIN and BLASTIX (NCBIA). One of the available algorithms or implementing software packages for conducting homology searches can be adapted for use in the present computer-based systems.

The most preferred sequence length of a target sequence is from about 10 to 100 amino acids or from about 30 to 300 nucleotide residues. However, it is well recognized that during searches for commercially important fragments of the nucleic acid molecules of the present invention, such as sequence fragments involved in gene expression and protein processing, may be of shorter length.

As used herein, "a target structural motif," or "target motif," refers to any rationally selected sequence or combination of sequences in which the sequences the sequence(s) are chosen based on a three-dimensional configuration which is formed upon the folding of the target motif. There are a variety of target motifs known in the art. Protein target motifs include, but are not limited to, enzymatic active sites and signal sequences. Nucleic acid target motifs include, but are not limited to, promoter sequences, *cis* elements, hairpin structures and inducible expression elements (protein binding sequences).

Thus, the present invention further provides an input means for receiving a target sequence, a data storage means for storing the target sequences of the present invention sequence identified using a search means as described above and an output means for outputting the identified homologous sequences. A variety of structural formats for the input and output means can be used to input and output information in the computer-based systems of the present invention. A preferred format for an output means ranks fragments of the sequence of the present invention by varying degrees of homology to the target sequence or target motif. Such presentation provides a skilled artisan with a ranking of sequences which contain various amounts of the target sequence or target motif and identifies the degree of homology contained in the identified fragment.

A variety of comparing means can be used to compare a target sequence or target motif with the data storage means to identify sequence fragments sequence of the present invention. For example, implementing software which implement the BLAST and BLAZE algorithms (Altschul *et al.*, *J. Mol. Biol.* 215:403-410 (1990)) can be used to identify open frames within the nucleic acid molecules of the present invention. A skilled artisan can readily recognize that any

one of the publicly available homology search programs can be used as the search means for the computer-based systems of the present invention.

Having now generally described the invention, the same will be more readily understood through reference to the following examples which are provided by way of illustration and are not intended to be limiting of the present invention, unless specified.

### **Example 1**

The MONN01 cDNA library is a normalized library generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) total leaf tissue at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The older, more juvenile leaves, which are in a basal position, as well as the younger, more adult leaves, which are more apical are cut at the base of the leaves. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.



The SATMON001 cDNA library is generated from maize (B73, Illinois Foundation Seeds, Champaign, Illinois U.S.A.) immature tassels at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in a greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue from the maize plant is collected at the V6 stage. At that stage the tassel is an immature tassel of about 2-3 cm in length. The tassels are removed and frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON003 library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign, Illinois U.S.A.) roots at the V6 developmental stage. Seeds are planted at a depth of approximately 3 cm in coil into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth, the seedlings are transplanted into 10 inch pots containing the Metro 200 growing medium. Plants are watered daily before transplantation and approximately 3 times a week after transplantation. Peters 15-16-17 fertilizer is applied approximately three times per week after transplanting at a concentration of 150 ppm N. Two to three times during the life time of the plant from transplanting to flowering a total of approximately 900 mg Fe is

added to each pot. Maize plants are grown in the green house in approximately 15hr day/9hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6 leaf development stage. The root system is cut from maize plant and washed with water to free it from the soil. The tissue is then immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON004 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign, Illinois U.S.A.) total leaf tissue at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The older, more juvenile leaves, which are in a basal position, as well as the younger, more adult leaves, which are more apical are cut at the base of the leaves. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation.

The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON005 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign Illinois, U.S.A.) root tissue at the V6 development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The root system is cut from the mature maize plant and washed with water to free it from the soil. The tissue is immediately frozen in liquid nitrogen and the harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON006 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign Illinois, U.S.A.) total leaf tissue at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three

times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The older more juvenile leaves, which are in a basal position, as well as the younger more adult leaves, which are more apical are cut at the base of the leaves. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON007 cDNA library is generated from the primary root tissue of 5 day old maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) seedlings. Seeds are planted on a moist filter paper on a covered tray that is kept in the dark until germination (one day). After germination, the trays, along with the moist paper, are moved to a greenhouse where the maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles for approximately 5 days. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. The primary root tissue is collected when the seedlings are 5 days old. At this stage, the primary root (radicle) is pushed through the coleorhiza which itself is pushed through the seed coat. The primary root, which is about 2-3 cm long, is cut and immediately frozen in liquid nitrogen and then stored at

-80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON008 cDNA library is generated from the primary shoot (coleoptile 2-3 cm) of maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) seedlings which are approximately 5 days old. Seeds are planted on a moist filter paper on a covered tray that is kept in the dark until germination (one day). Then the trays containing the seeds are moved to a greenhouse at 15hr daytime/9 hr nighttime cycles and grown until they are 5 days post germination. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Tissue is collected when the seedlings are 5 days old. At this stage, the primary shoot (coleoptile) is pushed through the seed coat and is about 2-3 cm long. The coleoptile is dissected away from the rest of the seedling, immediately frozen in liquid nitrogen and then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON009 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) leaves at the 8 leaf stage (V8 plant development stage). Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is 80°F and the nighttime temperature is

70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 8-leaf development stage. The older more juvenile leaves, which are in a basal position, as well as the younger more adult leaves, which are more apical, are cut at the base of the leaves. The leaves are then pooled and then immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON010 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) root tissue at the V8 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is 80°F and the nighttime temperature is 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the V8 development stage. The root system is cut from this mature maize plant and washed with water to free it from the soil. The tissue is immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

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The SATMON011 cDNA library is generated from undeveloped maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) leaf at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The second youngest leaf which is at the base of the apical leaf of V6 stage maize plant is cut at the base and immediately transferred to liquid nitrogen containers in which the leaf is crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON012 cDNA library is generated from 2 day post germination maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) seedlings. Seeds are planted on a moist filter paper on a covered tray that is kept in the dark until germination (one day). Then the trays containing the seeds are moved to the greenhouse and grown at 15hr daytime/9 hr nighttime cycles until 2 days post germination. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Tissue is collected when the seedlings are 2 days old. At the two day stage, the coleorhiza is pushed through the seed coat and the primary root

(the radicle) is pierced the coleorhiza but is barely visible. Also, at this two day stage, the coleoptile is just emerging from the seed coat. The 2 days post germination seedlings are then immersed in liquid nitrogen and crushed. The harvested tissue is stored at -80°C until preparation of total RNA. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON013 cDNA library is generated from apical maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) meristem founder at the V4 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Prior to tissue collection, the plant is at the 4 leaf stage. The lead at the apex of the V4 stage maize plant is referred to as the meristem founder. This apical meristem founder is cut, immediately frozen in liquid nitrogen and crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON014 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) endosperm fourteen days after pollination. Seeds are planted at a depth



of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium.

Plants are watered daily before transplantation and three times a week after transplantation.

The SATMON016 library is a maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.)

total of approximately 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15hr day/9hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. When the maize plants are at the V8 stage the 5<sup>th</sup> and 6<sup>th</sup> leaves from the bottom exhibit fully developed leaf blades. At the base of these leaves, the ligule is differentiated and the leaf blade is joined to the sheath. The sheath is dissected away from the base of the leaf then the sheath is frozen in liquid nitrogen and crushed. The tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON017 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) embryo seventeen days after pollination. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth the seeds are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. After the V10 stage, the ear shoots of maize plant, which are ready for fertilization, are enclosed in a paper bag before silk emergence to withhold the pollen. The ear shoots are fertilized and 21 days after pollination, the ears are pulled out and the kernels are plucked out of

the ears. Each kernel is then dissected into the embryo and the endosperm and the aleurone layer is removed. After dissection, the embryos are immediately frozen in liquid nitrogen and then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON019 (Lib3054) cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) culm (stem) at the V8 developmental stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. When the maize plant is at the V8 stage, the 5th and 6th leaves from the bottom have fully developed leaf blades. The region between the nodes of the 5th and the sixth leaves from the bottom is the region of the stem that is collected. The leaves are pulled out and the sheath is also torn away from the stem. This stem tissue is completely free of any leaf and sheath tissue. The stem tissue is then frozen in liquid nitrogen and stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON020 cDNA library is from a maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) Hill Type II-Initiated Callus. Petri plates containing approximately 25 ml of Type II initiation media are prepared. This medium contains N6 salts and vitamins, 3% sucrose, 2.3 g/liter proline 0.1 g/liter enzymatic casein hydrolysate, 2mg/liter 2,4 – dichloro phenoxy-acetic acid (2,4, D), 15.3 mg/liter AgNO<sub>3</sub> and 0.8% bacto agar and is adjusted to pH 6.0 before autoclaving. At 9-11 days after pollination, an ear with immature embryos measuring approximately 1-2 mm in length is chosen. The husks and silks are removed and then the ear is broken into halves and placed in an autoclaved solution of Clorox/TWEEN 20 sterilizing solution. Then the ear is rinsed with deionized water. Then each embryo is extracted from the kernel. Intact embryos are placed in contact with the medium, scutellar side up). Multiple embryos are plated on each plate and the plates are incubated in the dark at 25°C. Type II calluses are friable, can be subcultured with a spatula, frequently regenerate via somatic embryogenesis and are relatively undifferentiated. As seen in the microscope, the Tape II calluses show color ranging from translucent to light yellow and heterogeneity on with respect to embryoid structure as well as stage of embryoid development. Once Type II callus are formed, the calluses is transferred to type II callus maintenance medium without AgNO<sub>3</sub>. Every 7-10 days, the callus is subcultured. About 4 weeks after embryo isolation the callus is removed from the plates and then frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON021 cDNA library is generated from the immature maize (DK604, Dekalb Genetics, Dekalb Illinois, U.S.A.) tassel at the V8 plant development stage. Seeds are planted at

a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. As the maize plant enters the V8 stage, tassels which are 15-20 cm in length are collected and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON022 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) ear (growing silks) at the V8 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor

lamps. Tissue is collected when the plant is in the V8 stage. At this stage, some immature ear shoots are visible. The immature ear shoots (approximately 1 cm in length) are pulled out, frozen in liquid nitrogen and then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON23 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) ear (growing silk) at the V8 development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. When the tissue is harvested at the V8 stage, the length of the ear that is harvested is about 10-15 cm and the silks are just exposed (approximately 1 inch). The ear along with the silks is frozen in liquid nitrogen and then the tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON024 cDNA library is generated from the immature maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) tassel at the V9 development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing

medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. As a maize plant enters the V9 stage, the tassel is rapidly developing and a 37 cm tassel along with the glume, anthers and pollen is collected and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON025 cDNA library is from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) Hill Type II-Regenerated Callus. Type II callus is grown in initiation media as described for SATMON020 and then the embryoids on the surface of the Type II callus are allowed to mature and germinate. The 1-2 gm fresh weight of the soft friable type callus containing numerous embryoids are transferred to 100 x 15 mm petri plates containing 25 ml of regeneration media. Regeneration media consists of Murashige and Skoog (MS) basal salts, modified White's vitamins (0.2 g/liter glycine and 0.5 g/liter myo-inositol and 0.8% bacto agar (6SMS0D)). The plates are then placed in the dark after covering with parafilm. After 1 week, the plates are moved to a lighted growth chamber with 16 hr light and 8 hr dark photoperiod. Three weeks after plating the Type II callus to 6SMS0D, the callus exhibit shoot formation. The callus and the shoots are transferred to fresh 6SMS0D plates for another 2 weeks. The callus and the shoots are then transferred to petri plates with reduced sucrose (3SMS0D). Upon distinct formation of a root and shoot, the newly developed green plants are then removed out with a

spatula and frozen in liquid nitrogen containers. The harvested tissue is then stored at  $-80^{\circ}\text{C}$  until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON026 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) juvenile/adult shift leaves at the V8 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately  $80^{\circ}\text{F}$  and the nighttime temperature is approximately  $70^{\circ}\text{F}$ . Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plants are at the 8-leaf development stage. Leaves are founded sequentially around the meristem over weeks of time and the older, more juvenile leaves arise earlier and in a more basal position than the younger, more adult leaves, which are in a more apical position. In a V8 plant, some leaves which are in the middle portion of the plant exhibit characteristics of both juvenile as well as adult leaves. They exhibit a yellowing color but also exhibit, in part, a green color. These leaves are termed juvenile/adult shift leaves. The juvenile/adult shift leaves (the 4th, 5th leaves from the bottom) are cut at the base, pooled and transferred to liquid nitrogen in which they are then crushed. The harvested tissue is then stored



at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON027 cDNA library is generated from 6 day maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) leaves. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the Metro 200 growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Prior to tissue collection, when the plant is at the 8-leaf stage, water is held back for six days. The older, more juvenile leaves, which are in a basal position, as well as the younger, more adult leaves, which are more apical, are all cut at the base of the leaves. All the leaves exhibit significant wilting. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are then crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON028 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) roots at the V8 developmental stage that are subject to six days water stress. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing

Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the Metro 200 growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Prior to tissue collection, when the plant is at the 8-leaf stage, water is held back for six days. The root system is cut, shaken and washed to remove soil. Root tissue is then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are then crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON029 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) seedlings at the etiolated stage. Seeds are planted on a moist filter paper on a covered tray that is kept in the dark for 4 days at approximately 70°F. Tissue is collected when the seedlings are 4 days old. By 4 days, the primary root has penetrated the coleorhiza and is about 4-5 cm and the secondary lateral roots have also made their appearance. The coleoptile has also pushed through the seed coat and is about 4-5 cm long. The seedlings are frozen in liquid nitrogen and crushed. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

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flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is 80°F and the nighttime temperature is 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 4-leaf development stage. The third leaf from the bottom is cut at the base and immediately frozen in liquid nitrogen and crushed. The tissue is immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON033 cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) embryo tissue 13 days after pollination. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. After the V10 stage, the ear shoots of the maize plant, which are ready for fertilization, are enclosed in a paper bag before silk emergent to withhold the pollen. The ear shoots are pollinated and 13 days after pollination, the ears are pulled out and then the kernels are plucked out of the ears. Each kernel is then dissected into the embryo and the endosperm and the aleurone layer is removed. After dissection, the embryos are immediately frozen in liquid nitrogen and then

stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON034 cDNA library is generated from cold stressed maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) seedlings. Seeds are planted on a moist filter paper on a covered tray that is kept on at 10°C for 7 days. After 7 days, the temperature is shifted to 15°C for one day until germination of the seed. Tissue is collected once the seedlings are 1 day old. At this point, the coleorhiza has just pushed out of the seed coat and the primary root is just making its appearance. The coleoptile has not yet pushed completely through the seed coat and is also just making its appearance. These 1 day old cold stressed seedlings are frozen in liquid nitrogen and crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMON~001 (Lib36, Lib83, Lib84) cDNA library is generated from maize leaves at the V8 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in a greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue from the maize plant

is collected at the V8 stage. The older more juvenile leaves in a basal position as well as the younger more adult leaves which are more apical are all cut at the base, pooled and frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SATMONN01 cDNA library is generated from maize (B73, Illinois Foundation Seeds, Champaign, Illinois U.S.A.) normalized immature tassels at the V6 plant development stage normalized tissue. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in a greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue from the maize plant is collected at the V6 stage. At that stage the tassel is an immature tassel of about 2-3 cm in length. The tassels are removed and frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the normalized cDNA library is constructed as described in Example 2.

The SATMONN04 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign, Illinois U.S.A.) normalized total leaf tissue at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots

containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The older, more juvenile leaves, which are in a basal position, as well as the younger, more adult leaves, which are more apical are cut at the base of the leaves. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the normalized cDNA library is constructed as described in Example 2.

The SATMONN05 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign Illinois, U.S.A.) normalized root tissue at the V6 development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are

grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The root system is cut from the mature maize plant and washed with water to free it from the soil. The tissue is immediately frozen in liquid nitrogen and the harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the normalized cDNA library is constructed as described in Example 2.

The SATMONN06 cDNA library is generated from maize (B73 x Mo17, Illinois Foundation Seeds, Champaign Illinois, U.S.A.) normalized total leaf tissue at the V6 plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 6-leaf development stage. The older more juvenile leaves, which are in a basal position, as well as the younger more adult leaves, which are more apical are cut at the base of the leaves. The leaves are then pooled and immediately transferred to liquid nitrogen containers in which the pooled leaves are crushed. The harvested tissue is then stored at -80°C until RNA preparation.



The RNA is purified from the stored tissue and the normalized cDNA library is constructed as described in Example 2.

The CMZ029 (SATMON036) cDNA library is generated from maize (DK604, Dekalb Genetics, Dekalb, Illinois U.S.A.) endosperm 22 days after pollination. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the green house in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. After the V10 stage, the ear shoots of the maize plant, which are ready for fertilization, are enclosed in a paper bag before silk emergent to withhold the pollen. The ear shoots are pollinated and 22 days after pollination, the ears are pulled out and then the kernels are plucked out of the ears. Each kernel is then dissected into the embryo and the endosperm and the alurone layer is removed. After dissection, the endosperms are immediately frozen in liquid nitrogen and then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz030 (Lib143) cDNA library is generated from maize seedling tissue two days post germination. Seeds are planted on a moist filter paper on a covered try that is keep in the dark until germination. The trays are then moved to the bench top at 15 hr daytime/9 hr

nighttime cycles for 2 days post-germination. The day time temperature is 80°F and the nighttime temperature is 70°F. Tissue is collected when the seedlings are 2 days old. At this stage, the colehrhiza has pushed through the seed coat and the primary root (the radicle) is just piercing the colehrhiza and is barely visible. The seedlings are placed at 42°C for 1 hour. Following the heat shock treatment, the seedlings are immersed in liquid nitrogen and crushed. The harvested tissue is stored at -80° until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz031 (Lib148) cDNA library is generated from maize pollen tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F.

Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ stage plants. The ear shoots, which are ready for fertilization, are enclosed in a paper bag to withhold pollen. Twenty-one days after pollination, prior to removing the ears, the paper bag is shaken to collect the mature pollen. The mature pollen is immediately frozen in liquid nitrogen containers and the pollen is crushed. The harvested tissue is then stored at -80°C until

RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz033 (Lib189) cDNA library is generated from maize pooled leaf tissue. Samples are harvested from open pollinated plants. Tissue is collected from maize leaves at the anthesis stage. The leaves are collected from 10-12 plants and frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz034 (Lib3060) cDNA library is generated from maize mature tissue at 40 days post pollination plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F.

Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from leaves located two leaves below the ear leaf. This sample represents those genes expressed during onset and early stages of leaf senescence. The leaves are pooled and immediately transferred to liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

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The CMz035 (Lib3061) cDNA library is generated from maize endosperm tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ stage plants. The ear shoots, which are ready for fertilization, are enclosed in a paper bag prior to silk emergence to withhold pollen. Thirty-two days after pollination, the ears are pulled out and the kernels are removed from the cob. Each kernel is dissected into the embryo and the endosperm and the aleurone layer is removed. After dissection, the endosperms are immediately transferred to liquid nitrogen. The harvested tissue is then stored at 80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz036 (Lib3062) cDNA library is generated from maize husk tissue at the 8 week old plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during

the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from 8 week old plants. The husk is separated from the ear and immediately transferred to liquid nitrogen containers. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz037 (Lib3059) cDNA library is generated from maize pooled kernal at 12-15 days after pollination plant development stage. Sample were collected from field grown material. Whole kernals from hand pollinated (control pollination) are harvested as whole ears and immediately frozen on dry ice. Kernels from 10-12 ears were pooled and ground together in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz039 (Lib3066) cDNA library is generated from maize immature anther tissue at the 7 week old immature tassel stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime

temperature is approximately 80°F and the nighttime temperature is approximately 70°F.

Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is at the 7 week old immature tassel stage. At this stage, prior to anthesis, the immature anthers are green and enclosed in the staminate spikelet. The developing anthers are dissected away from the 7 week old immature tassel and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz040 (Lib3067) cDNA library is generated from maize kernel tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F.

Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ stage plants. The ear shoots, which are ready for fertilization, are enclosed in a paper bag before silk emergence to withhold pollen. Five to eight days after controlled pollination. The ears are pulled and the kernels removed. The kernels are immediately frozen in liquid nitrogen. This sample represents genes expressed in early kernel development, during periods of cell division, amyloplast biogenesis and early carbon flow across the material to filial tissue. The

harvested kernels tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz041 (Lib3068) cDNA library is generated from maize pollen germinating silk tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ stage plants when the ear shoots are ready for fertilization at the silk emergence stage. The emerging silks are pollinated with an excess of pollen under controlled pollination conditions in the green house. Eighteen hours after pollination the silks are removed from the ears and immediately frozen in liquid nitrogen. This sample represents genes expressed in both pollen and silk tissue early in pollination. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz042 (Lib3069) cDNA library is generated from maize ear tissue excessively pollinated at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they

are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F.

Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ stage plants and the ear shoots which are ready for fertilization are at the silk emergence stage. The immature ears are pollinated with an excess of pollen under controlled pollination conditions. Eighteen hours post-pollination, the ears are removed and immediately transferred to liquid nitrogen containers. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz044 (Lib3075) cDNA library is generated from maize microspore tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F.



Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from immature anthers from 7 week old tassels. The immature anthers are first dissected from the 7 week old tassel with a scalpel on a glass slide covered with water. The microspores (immature pollen) are released into the water and are recovered by centrifugation. The microspore suspension is immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz045 (Lib3076) cDNA library is generated from maize immature ear megaspore tissue. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from immature ear (megaspore) obtained from 7 week old plants. The immature ears are harvested from the 7 week old plants and are approximately 2.5 to 3 cm in length. The kernels are removed from the cob immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz047 (Lib3078) cDNA library is generated from maize CO<sub>2</sub> treated high-exposure shoot tissue at the V10+ plant development stage. RX601 maize seeds are sterilized for 1 minute with a 10% clorox solution. The seeds are rolled in germination paper, and germinated in 0.5 mM calcium sulfate solution for two days at 30°C. The seedlings are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium at a rate of 2-3 seedlings per pot. Twenty pots are placed into a high CO<sub>2</sub> environment (approximately 1000 ppm CO<sub>2</sub>). Twenty plants were grown under ambient greenhouse CO<sub>2</sub> (approximately 450 ppm CO<sub>2</sub>). Plants are watered daily before transplantation and three times a week after transplantation. Peters 20-20-20 fertilizer is also lightly applied. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. At ten days post planting, the shoots from both atmosphere are frozen in liquid nitrogen and lightly ground. The roots are washed in deionized water to remove the support media and the tissue is immediately transferred to liquid nitrogen containers. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz048 (Lib3079) cDNA library is generated from maize basal endosperm transfer layer tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to

three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected from V10+ maize plants. The ear shoots, which are ready for fertilization, are enclosed in a paper bag prior to silk emergence, to withhold the pollen. Kernels are harvested at 12 days post-pollination and placed on wet ice for dissection. The kernels are cross sectioned laterally, dissecting just above the pedicel region, including 1-2 mm of the lower endosperm and the basal endosperm transfer region. The pedicel and lower endosperm region containing the basal endosperm transfer layer is pooled and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz049(Lib3088) cDNA library is generated from maize immature anther tissue at the 7 week old immature tassel stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the

maize plant is at the 7 week old immature tassel stage. At this stage, prior to anthesis, the immature anthers are green and enclosed in the staminate spikelet. The developing anthers are dissected away from the 7 week old immature tassel and immediately transferred to liquid nitrogen container. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The CMz050 (Lib3114) cDNA library is generated from maize silk tissue at the V10+ plant development stage. Seeds are planted at a depth of approximately 3 cm into 2-3 inch peat pots containing Metro 200 growing medium. After 2-3 weeks growth they are transplanted into 10 inch pots containing the same growing medium. Plants are watered daily before transplantation and three times a week after transplantation. Peters 15-16-17 fertilizer is applied three times per week after transplanting at a strength of 150 ppm N. Two to three times during the lifetime of the plant, from transplanting to flowering, a total of 900 mg Fe is added to each pot. Maize plants are grown in the greenhouse in 15 hr day/9 hr night cycles. The daytime temperature is approximately 80°F and the nighttime temperature is approximately 70°F. Supplemental lighting is provided by 1000 W sodium vapor lamps. Tissue is collected when the maize plant is beyond the 10-leaf development stage and the ear shoots are approximately 15-20 cm in length. The ears are pulled and silks are separated from the ears and immediately transferred to liquid nitrogen containers. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON001 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) total leaf tissue at the V4 plant development stage. Leaf tissue from 38, field grown V4 stage plants is harvested from the 4<sup>th</sup> node. Leaf tissue is removed from the plants and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON002 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) root tissue at the V4 plant development stage. Root tissue from 76, field grown V4 stage plants is harvested. The root systems is cut from the soybean plant and washed with water to free it from the soil and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON003 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seedling hypocotyl axis tissue harvested 2 day post-imbibition. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium. Trays are placed in an environmental chamber and grown at 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Tissue is collected 2 days after the start of imbibition. The 2 days after imbibition samples are separated into 3 collections after removal of any adhering seed coat. At the 2 day stage, the hypocotyl axis is emerging from the soil. A few seedlings have cracked the soil surface and exhibited slight greening of the exposed cotyledons. The seedlings are washed in water to remove soil, hypocotyl axis harvested and immediately frozen in liquid nitrogen. The

harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON004 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seedling cotyledon tissue harvested 2 day post-imbibition. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium. Trays are placed in an environmental chamber and grown at 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Tissue is collected 2 days after the start of imbibition. The 2 days after imbibition samples are separated into 3 collections after removal of any adhering seed coat. At the 2 day stage, the hypocotyl axis is emerging from the soil. A few seedlings have cracked the soil surface and exhibited slight greening of the exposed cotyledons. The seedlings are washed in water to remove soil, hypocotyl axis harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON005 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seedling hypocotyl axis tissue harvested 6 hour post-imbibition. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium. Trays are placed in an environmental chamber and grown at 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Tissue is collected 6 hours after the start of imbibition. The 6 hours after imbibition samples are separated into 3 collections after removal of any adhering seed coat. The

6 hours after imbibition sample is collected over the course of approximately 2 hours starting at 6 hours post imbibition. At the 6 hours after imbibition stage, not all cotyledons have become fully hydrated and germination, or radicle protrusion, has not occurred. The seedlings are washed in water to remove soil, hypocotyl axis harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON006 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seedling cotyledons tissue harvest 6 hour post-imbibition. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium. Trays are placed in an environmental chamber and grown at 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Tissue is collected 6 hours after imbibition. The 6 hours after imbibition samples are separated into 3 collections after removal of any adhering seed coat. The 6 hours after imbibition sample is collected over the course of approximately 2 hours starting at 6 hours post-imbibition. At the 6 hours after imbibition, not all cotyledons have become fully hydrated and germination or radicle protrusion, have not occurred. The seedlings are washed in water to remove soil, cotyledon harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON007 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seed tissue harvested 25 and 35 days post-flowering. Seed pods from field grown plants are harvested 25 and 35 days after flowering and

the seeds extracted from the pods. Approximately 4.4g and 19.3g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON008 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) leaf tissue harvested from 25 and 35 days post-flowering plants. Total leaf tissue is harvested from field grown plants. Approximately 19g and 29g of leaves are harvested from the fourth node of the plant 25 and 35 days post-flowering and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON009 cDNA library is generated from soybean cutlivar C1944 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) pod and seed tissue harvested 15 days post-flowering. Pods from field grown plants are harvested 15 days post-flowering. Approximately 3g of pod tissue is harvested and immediately-frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON010 cDNA library is generated from soybean cultivar C1944 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) seed tissue harvested 40 days post-flowering. Pods from field grown plants are harvested 40 days post-flowering. Pods and seeds are separated, approximately 19g of seed tissue is harvested and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.



The SOYMON011 cDNA library is generated from soybean cultivars Cristalina (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) and FT108 (Monsoy, Brazil) (tropical germ plasma) leaf tissue. Leaves are harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Approximately 30g of leaves are harvested from the 4<sup>th</sup> node of each of the Cristalina and FT108 cultivars and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON012 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) leaf tissue. Leaves from field grown plants are harvested from the fourth node 15 days post-flowering. Approximately 12g of leaves are harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON013 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) root and nodule tissue. Approximately, 28g of root tissue from field grown plants is harvested 15 days post-flowering. The root system is cut from the soybean plant, washed with water to free it from the soil and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON014 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seed tissue harvested 25 and 35 days after

flowering. Seed pods from field grown plants are harvested 15 days after flowering and the seeds extracted from the pods. Approximately 5g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON015 cDNA is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seed tissue harvested 45 and 55 days post-flowering. Seed pods from field grown plants are harvested 45 and 55 days after flowering and the seeds extracted from the pods. Approximately 19g and 31g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON016 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) root tissue. Approximately, 61g and 38g of root tissue from field grown plants is harvested 25 and 35 days post- flowering is harvested. The root system is cut from the soybean plant and washed with water to free it from the soil. The tissue is placed in 14ml polystyrene tubes and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON017 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) root tissue. Approximately 28g of root tissue from field grown plants is harvested 45 and 55 days post-flowering. The root system is cut from the soybean plant, washed with water to free it from the soil and immediately frozen in dry-

ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON018 cDNA is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) leaf tissue harvested 45 and 55 days post-flowering. Leaves from field grown plants are harvested 45 and 55 days after flowering from the fourth node. Approximately 27g and 33g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON019 cDNA library is generated from soybean cultivars Cristalina (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) and FT108 (Monsoy, Brazil) (tropical germ plasma) root tissue. Roots are harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Approximately 50g and 56g of roots are harvested from each of the Cristalina and FT108 cultivars and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON020 cDNA is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seed tissue harvested 65 and 75 days post-flowering. Seed pods from field grown plants are harvested 45 and 55 days after flowering and the seeds extracted from the pods. Approximately 14g and 31g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until

RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON021 cDNA library is generated from Soybean Cyst Nematode-resistant soybean cultivar Hartwig (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) root tissue. Plants are grown in tissue culture at room temperature. At approximately 6 weeks post-germination, the plants are exposed to sterilized Soybean Cyst Nematode eggs. Infection is then allowed to progress for 10 days. After the 10 day infection process, the tissue is harvested. Agar from the culture medium and nematodes are removed and the root tissue is immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON022 (Lib3030) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) partially opened flower tissue. Partially to fully opened flower tissue is harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. A total of 3g of flower tissue is harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON023 cDNA library is generated from soybean genotype BW211S Null (Tohoku University, Morioka, Japan) seed tissue harvested 15 and 40 days post-flowering. Seed pods from field grown plants are harvested 15 and 40 days post-flowering and the seeds extracted from the pods. Approximately 0.7g and 14.2g of seeds are harvested from the respective seed pods and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA

preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON024 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) internode-2 tissue harvested 18 days post-imbibition. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium. The plants are grown in a greenhouse for 18 days after the start of imbibition at ambient temperature. Soil is checked and watered daily to maintain even moisture conditions. Stem tissue is harvested 18 days after the start of imbibition. The samples are divided into hypocotyl and internodes 1 through 5. The fifth internode contains some leaf bud material. Approximately 3 g of each sample is harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON025 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) leaf tissue harvested 65 days post-flowering. Leaves are harvested from the fourth node of field grown plants 65 days post-flowering. Approximately 18.4g of leaf tissue is harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

SOYMON026 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) root tissue harvested 65 and 75 days post-flowering. Approximately 27g and 40g of root tissue from field grown plants is harvested 65 and 75 days post-flowering. The root system is cut from the soybean plant, washed with water to free it from the soil and immediately frozen in dry-ice. The harvested tissue is then stored at -80°C until

RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON027 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) pod tissue, without seeds, harvested 25 days post-flowering. Seed pods from field grown plants are harvested 25 days post-flowering and the seeds extracted from the pods. Approximately 17g of seed pod tissue is harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON028 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) drought-stressed root tissue. The plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. At the R3 stage of development, water is withheld from half of the plant collection (drought stressed population). After 3 days, half of the plants from the drought stressed condition and half of the plants from the control population are harvested. After another 3 days (6 days post drought induction) the remaining plants are harvested. A total of 27g and 40g of root tissue is harvested and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON029 cDNA library is generated from Soybean Cyst Nematode-resistant soybean cultivar PI07354 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) root tissue. Late fall to early winter greenhouse grown plants are exposed to Soybean Cyst Nematode

eggs. At 10 days post-infection, the plants are uprooted, rinsed briefly and the roots frozen in liquid nitrogen. Approximately 20 grams of root tissue is harvested from the infected plants. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON030 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) flower bud tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Flower buds are removed from the plant at the pedicel. A total of 100mg of flower buds are harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON031 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) carpel and stamen tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Flower buds are removed from the plant at the pedicel. Flowers are dissected to separate petals, sepals and reproductive structures (carpels and stamens). A total of 300mg of carpel and stamen tissue are harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C

until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON032 cDNA library is prepared from the Asgrow cultivar A4922 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) rehydrated dry soybean seed meristem tissue. Surface sterilized seeds are germinated in liquid media for 24 hours. The seed axis is then excised from the barely germinating seed, placed on tissue culture media and incubated overnight at 20°C in the dark. The supportive tissue is removed from the explant prior to harvest. Approximately 570mg of tissue is harvested and frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON033 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) heat-shocked seedling tissue without cotyledons. Seeds are imbibed and germinated in vermiculite for 2 days under constant illumination. After 48 hours, the seedlings are transferred to an incubator set at 40°C under constant illumination. After 30, 60 and 180 minutes seedlings are harvested and dissected. A portion of the seedling consisting of the root, hypocotyl and apical hook is frozen in liquid nitrogen and stored at -80°C. The seedlings after 2 days of imbibition are beginning to emerge from the vermiculite surface. The apical hooks are dark green in appearance. Total RNA and poly A<sup>+</sup> RNA is prepared from equal amounts of pooled tissue. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON034 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) cold-shocked seedling tissue without cotyledons. Seeds are imbibed and germinated in vermiculite for 2 days under constant



illumination. After 48 hours, the seedlings are transferred to a cold room set at 5°C under constant illumination. After 30, 60 and 180 minutes seedlings are harvested and dissected. The seedlings after 2 days of imbibition are beginning to emerge from the vermiculite surface. The apical hooks are dark green in appearance. A portion of the seedling consisting of the root, hypocotyl and apical hook is frozen in liquid nitrogen and stored at -80°C. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON035 cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seed coat tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. Seeds are harvested from mid to nearly full maturation (seed coats are not yellowing). The entire embryo proper is removed from the seed coat sample and the seed coat tissue are harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON036 cDNA library is generated from soybean cultivars PI171451, PI227687 and PI229358 (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) insect challenged leaves. Plants from each of the three cultivars are grown in screenhouse conditions. The screenhouse is divided in half and one half of the screenhouse is infested with soybean looper and the other half infested with velvetbean caterpillar. A single leaf is taken from each of the representative plants at 3 different time points, 11 days after infestation, 2 weeks after infestation and 5 weeks after infestation and immediately frozen in liquid nitrogen. The

harvested tissue is then stored at -80°C until RNA preparation. Total RNA and poly A+ RNA is isolated from pooled tissue consisting of equal quantities of all 18 samples (3 genotypes X 3 sample times X 2 insect genotypes). The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON037 cDNA library is generated from soybean cultivar A3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) etiolated axis and radical tissue. Seeds are planted in moist vermiculite, wrapped and kept at room temperature in complete darkness until harvest. Etiolated axis and hypocotyl tissue is harvested at 2, 3 and 4 days post-planting. A total of 1 gram of each tissue type is harvested at 2, 3 and 4 days after planting and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The SOYMON038 cDNA library is generated from soybean variety Asgrow A3237 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) rehydrated dry seeds. Explants are prepared for transformation after germination of surface-sterilized seeds on solid tissue media. After 6 days, at 28°C and 18 hours of light per day, the germinated seeds are cold shocked at 4°C for 24 hours. Meristemic tissue and part of the hypocotyl is removed and cotyledon excised. The prepared explant is then wounded for *Agrobacterium* infection. The 2 grams of harvested tissue is frozen in liquid nitrogen and stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The Soy51 (LIB3027) normalized seed pool cDNA library is prepared from equal amounts tissue harvested from SOYMON007, SOYMON015 and SOYMON020 prepared tissue. Single stranded and double stranded DNA representing approximately  $1 \times 10^6$  colony forming units are isolated using standard protocols. RNA, complementary to the single stranded DNA, is

synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. The non-hybridized single stranded molecules remaining after hybrid capture are converted to double stranded form and represent the primary normalized library.

The Soy52 (LIB3028) cDNA library is generated from normalized flower DNA. Single stranded DNA representing approximately  $1 \times 10^6$  colony forming units of SOYMON022 harvested tissue is used as the starting material for normalization. RNA, complementary to the single stranded DNA, is synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. The non-hybridized single stranded molecules remaining after hybrid capture are converted to double stranded form and represent the primary normalized library.

The Soy53 (LIB3039) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) seedling shoot apical meristem tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. Apical tissue is

harvested from seedling shoot meristem tissue, 7-8 days after the start of imbibition. The apex of each seedling is dissected to include the fifth node to the apical meristem. The fifth node corresponds to the third trifoliate leaf in the very early stages of development. Stipules completely envelop the leaf primordia at this time. A total of 200mg of apical tissue is harvested and immediately frozen in liquid nitrogen. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

The Soy54 (LIB3040) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) heart to torpedo stage embryo tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. Seeds are collected and embryos removed from surrounding endosperm and maternal tissues. Embryos from globular to young torpedo stages (by corresponding analogy to *Arabidopsis*) are collected with a bias towards the middle of this spectrum. Embryos which are beginning to show asymmetric development of cotyledons are considered the upper developmental boundary for the collection and are excluded. A total of 12 mg embryo tissue is frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

Soy55 (LIB3049) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) young seed tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the

plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. Seeds are collected from very young pods (5 to 15 days after flowering). A total of 100mg of seeds are harvested and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is purified from the stored tissue and the cDNA library is constructed as described in Example 2.

Soy56 (LIB3029) non-normalized seed pool cDNA library is prepared from equal amounts tissue harvested from SOYMON007, SOYMON015 and SOYMON020 prepared tissue. Single stranded and double stranded DNA representing approximately  $1 \times 10^6$  colony forming units are isolated using standard protocols. RNA, complementary to the single stranded DNA, is synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. The non-hybridized single stranded molecules remaining after hybrid capture are not converted to double stranded form and represent a non-normalized seed pool for comparison to Soy51 cDNA libraries.

TheSoy58 (LIB3050) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) drought stressed root tissue subtracted from control root tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the

nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. At the R3 stage of the plant drought is induced by withholding water. After 3 and 6 days root tissue from both drought stressed and control (watered regularly) plants are collected and frozen in dry-ice. The harvested tissue is stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the subtracted cDNA library is constructed as described in Example 2.

The Soy59 (LIB3051) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) endosperm tissue. Seeds are germinated on paper towels under laboratory ambient light conditions. At 8, 10 and 14 hours after imbibition, the seed coats are harvested. The endosperm consists of a very thin layer of tissue affixed to the inside of the seed coat. The seed coat and endosperm are frozen immediately after harvest in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the cDNA library is constructed as described in Example 2.

The Soy60 (LIB3072) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) drought stressed seed plus pod subtracted from control seed plus pod tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 26°C and the nighttime temperature 21°C and 70% relative humidity. Soil is checked and watered daily to maintain even moisture conditions. At the R3 stage of the plant drought is induced by withholding water. After 3 and 6 days seeds and pods from both drought stressed and control (watered regularly) plants are collected from the fifth and sixth node and frozen in dry-

ice. The harvested tissue is stored at  $-80^{\circ}\text{C}$  until RNA preparation. The RNA is prepared from the stored tissue and the subtracted cDNA library is constructed as described in Example 2.

The Soy61 (LIB3073) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) jasmonic acid treated seedling subtracted from control tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in a greenhouse. The daytime temperature is approximately  $29.4^{\circ}\text{C}$  and the nighttime temperature  $20^{\circ}\text{C}$ . Soil is checked and watered daily to maintain even moisture conditions. At 9 days post planting, the plantlets are sprayed with either control buffer of 0.1% Tween-20 or jasmonic acid (Sigma J-2500, Sigma, St. Louis, Missouri U.S.A.) at 1 mg/ml in 0.1% Tween-20. Plants are sprayed until runoff and the soil and the stem is soaked with the spraying solution. At 18 hours post application of jasmonic acid, the soybean plantlets appear growth retarded. After 18 hours, 24 hours and 48 hours post treatment, the cotyledons are removed and the remaining leaf and stem tissue above the soil is harvested and frozen in liquid nitrogen. The harvested tissue is stored at  $-80^{\circ}\text{C}$  until RNA preparation. To make RNA, the three sample timepoints were combined and ground. The RNA is prepared from the stored tissue and the subtracted cDNA library is constructed as described in Example 2. For this library's construction, the eighth fraction of the cDNA size fractionation step was used for ligation.

The Soy62 (LIB3074) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) jasmonic acid treated seedling subtracted from control tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in a greenhouse. The daytime temperature is approximately  $29.4^{\circ}\text{C}$  and the nighttime temperature  $20^{\circ}\text{C}$ . Soil is checked and

watered daily to maintain even moisture conditions. At 9 days post planting, the plantlets are sprayed with either control buffer of 0.1% Tween-20 or jasmonic acid (Sigma J-2500, Sigma, St. Louis, Missouri U.S.A.) at 1 mg/ml in 0.1% Tween-20. Plants are sprayed until runoff and the soil and the stem is soaked with the spraying solution. At 18 hours post application of jasmonic acid, the soybean plantlets appear growth retarded. After 18 hours, 24 hours and 48 hours post treatment, the cotyledons are removed and the remaining leaf and stem tissue above the soil is harvested and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. To make RNA, the three sample timepoints were combined and ground. The RNA is prepared from the stored tissue and the subtracted cDNA library is constructed as described in Example 2. For this library's construction, the ninth fraction of the cDNA size fractionation step was used for ligation.

The Soy65 (LIB3107) 07cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) drought-stressed abscission zone tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature 24°C. Soil is checked and watered daily to maintain even moisture conditions. Plants are irrigated with 15-16-17 Peter's Mix. At the R3 stage of development, drought is imposed by withholding water. At 3, 4, 5 and 6 days, tissue is harvested and wilting is not obvious until the fourth day. Abscission layers from reproductive organs are harvested by cutting less than one millimeter proximal and distal to the layer and immediately frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the cDNA library is constructed as described in Example 2.



The Soy66 (LIB3109) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) non-drought stressed abscission zone tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Plants are irrigated with 15-16-17 Peter's Mix. At 3, 4, 5 and 6 days, control abscission layer tissue is harvested. Abscission layers from reproductive organs are harvested by cutting less than one millimeter proximal and distal to the layer and immediately frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the cDNA library is constructed as described in Example 2.

Soy67 (LIB3065) normalized seed pool cDNA library is prepared from equal amounts tissue harvested from SOYMON007, SOYMON015 and SOYMON020 prepared tissue. Single stranded and double stranded DNA representing approximately  $1 \times 10^6$  colony forming units are isolated using standard protocols. RNA, complementary to the single stranded DNA, is synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio) and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. Captured hybrids are eluted with water.

Soy68 (LIB3052) normalized seed pool cDNA library is prepared from equal amounts tissue harvested from SOYMON007, SOYMON015 and SOYMON020 prepared tissue. Single

stranded and double stranded DNA representing approximately  $1 \times 10^6$  colony forming units are isolated using standard protocols. RNA, complementary to the single stranded DNA, is synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio) and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. Captured hybrids are eluted with water.

Soy69 (LIB3053) normalized cDNA library is generated from soybean cultivars Cristalina (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) and FT108 (Monsoy, Brazil) (tropical germ plasma) normalized leaf tissue. Leaves are harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Approximately 30g of leaves are harvested from the 4<sup>th</sup> node of each of the Cristalina and FT108 cultivars and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the normalized cDNA library is constructed as described in Example 2.

Soy70 (LIB3055) cDNA library is generated from soybean cultivars Cristalina (USDA Soybean Germplasm Collection, Urbana, Illinois U.S.A.) and FT108 (Monsoy, Brazil) (tropical germ plasma) leaf tissue. Leaves are harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain

even moisture conditions. Approximately 30g of leaves are harvested from the 4<sup>th</sup> node of each of the Cristalina and FT108 cultivars and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the cDNA library is constructed as described in Example 2.

Soy71 (LIB3056) cDNA library is generated from soybean cultivars Cristalina and FT108 (tropical germ plasma) root tissue. Roots are harvested from plants grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 29°C and the nighttime temperature approximately 24°C. Soil is checked and watered daily to maintain even moisture conditions. Approximately 50g and 56g of roots are harvested from each of the Cristalina and FT108 cultivars and immediately frozen in dry ice. The harvested tissue is then stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the cDNA library is constructed as described in Example 2.

Soy73 (LIB3093) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) drought stressed leaf subtracted from control tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in an environmental chamber under 12hr daytime/12hr nighttime cycles. The daytime temperature is approximately 26°C and the nighttime temperature 21°C and 70% relative humidity. Soil is checked and watered daily to maintain even moisture conditions. At the R3 stage of the plant drought is induced by withholding water. After 3 and 6 days seeds and pods from both drought stressed and control (watered regularly) plants are collected from the fifth and sixth node and frozen in dry-ice. The harvested tissue is stored at -80°C until RNA preparation. The RNA is prepared from the stored tissue and the subtraction cDNA library is constructed as described in Example 2.

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The Soy76 (Lib3106) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) jasmonic acid and arachidonic treated seedling subtracted from control tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in a greenhouse. The daytime temperature is approximately 29.4°C and the nighttime temperature 20°C. Soil is checked and watered daily to maintain even moisture conditions. At 9 days post planting, the plantlets are sprayed with either control buffer of 0.1% Tween-20 or jasmonic acid (Sigma J-2500, Sigma, St. Louis, Missouri U.S.A.) at 1 mg/ml in 0.1% Tween-20. Plants are sprayed until runoff and the soil and the stem is soaked with the spraying solution. At 18 hours post application of jasmonic acid, the soybean plantlets appear growth retarded. Arachidonic treated seedlings are sprayed with 1m/ml arachidonic acid in 0.1% Tween-20. After 18hours, 24hours and 48 hours post treatment, the cotyledons are removed and the remaining leaf and stem tissue above the soil is harvested and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. To make RNA, the three sample timepoints were combined and ground. The RNA from the arachidonic treated seedlings is isolated separately. The RNA is prepared from the stored tissue and the subtraction cDNA library is constructed as described in Example 2. For this subtraction library, fraction 10 of the size fractionated cDNA is ligated into the pSPORT vector (Invitrogen, Carlsbad California U.S.A.) in order to capture some of the smaller transcripts characteristic of antifungal proteins.

Soy77 (LIB3108) cDNA library is generated from soybean cultivar Asgrow 3244 (Asgrow Seed Company, Des Moines, Iowa U.S.A.) jasmonic acid control tissue. Seeds are planted at a depth of approximately 2cm into 2-3 inch peat pots containing Metromix 350 medium and the plants are grown in a greenhouse. The daytime temperature is approximately

29.4°C and the nighttime temperature 20°C. Soil is checked and watered daily to maintain even moisture conditions. At 9 days post planting, the plantlets are sprayed with either control buffer of 0.1% Tween-20 or jasmonic acid (Sigma J-2500, Sigma, St. Louis, Missouri U.S.A.) at 1 mg/ml in 0.1% Tween-20. Plants are sprayed until runoff and the soil and the stem is soaked with the spraying solution. At 18 hours post application of jasmonic acid, the soybean plantlets appear growth retarded. Arachidonic treated seedlings are sprayed with 1m/ml arachidonic acid in 0.1% Tween-20. After 18 hours, 24 hours and 48 hours post treatment, the cotyledons are removed and the remaining leaf and stem tissue above the soil is harvested and frozen in liquid nitrogen. The harvested tissue is stored at -80°C until RNA preparation. To make RNA, the three sample timepoints were combined and ground. The RNA from the arachidonic treated seedlings is isolated separately. The RNA is prepared from the stored tissue and the subtraction cDNA library is constructed as described in Example 2. For this subtraction cDNA library, fraction 10 of the size fractionated cDNA is ligated into the pSPORT vector in order to capture some of the smaller transcripts characteristic of antifungal proteins.

### Example 2

The stored RNA is purified using Trizol reagent from Life Technologies (Gibco BRL, Life Technologies, Gaithersburg, Maryland U.S.A.), essentially as recommended by the manufacturer. Poly A+ RNA (mRNA) is purified using magnetic oligo dT beads essentially as recommended by the manufacturer (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.).

Construction of plant cDNA libraries is well-known in the art and a number of cloning strategies exist. A number of cDNA library construction kits are commercially available. The

Superscript™ Plasmid System for cDNA synthesis and Plasmid Cloning (Gibco BRL, Life Technologies, Gaithersburg, Maryland U.S.A.) is used, following the conditions suggested by the manufacturer.

Normalized libraries are made using essentially the Soares procedure (Soares *et al.*, *Proc. Natl. Acad. Sci. (U.S.A.)* 91:9228-9232 (1994), the entirety of which is herein incorporated by reference). This approach is designed to reduce the initial 10,000-fold variation in individual cDNA frequencies to achieve abundances within one order of magnitude while maintaining the overall sequence complexity of the library. In the normalization process, the prevalence of high-abundance cDNA clones decreases dramatically, clones with mid-level abundance are relatively unaffected and clones for rare transcripts are effectively increased in abundance.

Normalized libraries are prepared from single-stranded and double-stranded DNA. Single-stranded and double-stranded DNA representing approximately  $1 \times 10^6$  colony forming units are isolated using standard protocols. RNA, complementary to the single-stranded DNA, is synthesized using the double stranded DNA as a template. Biotinylated dATP is incorporated into the RNA during the synthesis reaction. The single-stranded DNA is mixed with the biotinylated RNA in a 1:10 molar ratio) and allowed to hybridize. DNA-RNA hybrids are captured on Dynabeads M280 streptavidin (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The dynabeads with captured hybrids are collected with a magnet. The non-hybridized single-stranded molecules remaining after hybrid capture are converted to double stranded form and represent the primary normalized library.

For subtraction, target cDNA is made from the drought stressed tissue total RNA using the SMART cDNA synthesis system from Clontech (Clontech Laboratories, Palo Alto,

California U.S.A.). Driver first strand cDNA is covalently linked to Dynabeads following a protocol similar to that described in the Dynal literature (Dynabeads, Dynal Corporation, Lake Success, New York U.S.A.). The target cDNA is then heat denatured and the second strand trapped using Dynabeads oligo-dT. The target second strand cDNA is then hybridized to the driver cDNA in 400 l 2X SSPE for two rounds of hybridization at 65°C and 20 hours. After each hybridization, the hybridization solution is removed from the system and the hybridized target cDNA removed from the driver by heat denaturation in water. After hybridization, the remaining cDNA is trapped with Dynabeads oligo-dT. The trapped cDNA is then amplified as in previous PCR based libraries and the resulting cDNA ligated into the pSPORT vector (Invitrogen, Carlsbad California U.S.A.).

### Example 3

The cDNA libraries are plated on LB agar containing the appropriate antibiotics for selection and incubated at 37° for a sufficient time to allow the growth of individual colonies. Single colonies are individually placed in each well of a 96-well microtiter plates containing LB liquid including the selective antibiotics. The plates are incubated overnight at approximately 37°C with gentle shaking to promote growth of the cultures. The plasmid DNA is isolated from each clone using Qiaprep plasmid isolation kits, using the conditions recommended by the manufacturer (Qiagen Inc., Santa Clara, California U.S.A.).

Template plasmid DNA clones are used for subsequent sequencing. For sequencing, the ABI PRISM dRhodamine Terminator Cycle Sequencing Ready Reaction Kit with AmpliTaq® DNA Polymerase, FS, is used (PE Applied Biosystems, Foster City, California U.S.A.).

#### Example 4

Nucleic acid sequences that encode for the following carbon assimilation pathway enzymes: ribulose-bisphosphate carboxylase, phosphoglycerate kinase, glyceraldehyde 3-phosphate dehydrogenase, putative glyceraldehyde 3-phosphate dehydrogenase, triose phosphate isomerase, aldolase, fructose-1,6-bisphosphatase, transketolase, putative transketolase, sedoheptulose-1,7-bisphosphatase, D-ribulose-5-phosphate-3-epimerase, ribose-5-phosphate isomerase, putative ribose-5-phosphate isomerase, ribose-5-phosphate kinase, phosphoenolpyruvate carboxylase, NADP-dependent malate dehydrogenase, aspartate aminotransferase, putative aspartate aminotransferase, alanine aminotransferase, NADP-dependent malic enzyme, NAD-dependent malic enzyme, PEP carboxykinase, putative PEP carboxykinase, pyruvate, phosphate dikinase and pyrophosphatase are identified from the Monsanto EST PhytoSeq database using TBLASTN (default values)(TBLASTN compares a protein query against the six reading frames of a nucleic acid sequence). Matches found with BLAST P values equal or less than 0.001 (probability) or BLAST Score of equal or greater than 90 are classified as hits. If the program used to determine the hit is HMMSW then the score refers to HMMSW score.

In addition, the GenBank database is searched with BLASTN and BLASTX (default values) using ESTs as queries. EST that pass the hit probability threshold of  $10e^{-8}$  for the following enzymes are combined with the hits generated by using TBLASTN (described above) and classified by enzyme (see Table A below).

A cluster refers to a set of overlapping clones in the PhytoSeq database. Such an overlapping relationship among clones is designated as a “cluster” when BLAST scores from



pairwise sequence comparisons of the member clones meets a predetermined minimum value or product score of 50 or more (Product Score = (BLAST SCORE x Percentage Identity)/(5 x minimum [length (Seq1), length (Seq2)]))

Since clusters are formed on the basis of single-linkage relationships, it is possible for two non-overlapping clones to be members of the same cluster if, for instance, they both overlap a third clone with at least the predetermined minimum BLAST score (stringency). A cluster ID is arbitrarily assigned to all of those clones which belong to the same cluster at a given stringency and a particular clone will belong to only one cluster at a given stringency. If a cluster contains only a single clone (a "singleton"), then the cluster ID number will be negative, with an absolute value equal to the clone ID number of its single member. Clones grouped in a cluster in most cases represent a contiguous sequence.

09537305.44604

TABLE A\*

MAIZE RIBULOSE-BISPHOSPHATE CARBOXYLASE								
Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
1	-700430856	700430856H1	SATMONN01	g22464	BLASTN	215	1e-9	100
2	21707	700433144H1	SATMONN01	g22464	BLASTN	626	1e-45	95
3	21707	700433148H1	SATMONN01	g22464	BLASTN	626	1e-45	95
4	3272	700098783H1	SATMON009	g217963	BLASTN	1535	1e-128	98
5	3272	700097213H1	SATMON009	g217963	BLASTN	1316	1e-121	99
6	3272	700097673H1	SATMON009	g217963	BLASTN	1540	1e-121	96
7	3272	700101767H1	SATMON009	g1673455	BLASTN	1095	1e-120	100
8	3272	700100001H1	SATMON009	g1673455	BLASTN	910	1e-119	99
9	3272	700097382H1	SATMON009	g217963	BLASTN	1517	1e-119	96
10	3272	700099925H1	SATMON009	g217963	BLASTN	1522	1e-119	97
11	3272	700098235H1	SATMON009	g217963	BLASTN	1512	1e-118	97
12	3272	700093043H1	SATMON008	g1673455	BLASTN	1070	1e-117	100
13	3272	700089802H1	SATMON011	g217963	BLASTN	996	1e-115	95
14	3272	700101196H1	SATMON009	g217963	BLASTN	1478	1e-115	99
15	3272	700097309H1	SATMON009	g217963	BLASTN	1482	1e-115	97
16	3272	700100270H1	SATMON009	g217963	BLASTN	1466	1e-114	96
17	3272	700208152H1	SATMON016	g1673455	BLASTN	1090	1e-113	99
18	3272	700215709H1	SATMON016	g1673455	BLASTN	1105	1e-113	98
19	3272	700100795H1	SATMON009	g217963	BLASTN	1452	1e-113	98
20	3272	700097496H1	SATMON009	g217963	BLASTN	1416	1e-110	99
21	3272	700099783H1	SATMON009	g217963	BLASTN	1427	1e-110	97
22	3272	700044355H1	SATMON004	g217963	BLASTN	1326	1e-109	96
23	3272	700099951H1	SATMON009	g217963	BLASTN	1409	1e-109	96
24	3272	700100228H1	SATMON009	g217963	BLASTN	999	1e-108	97
25	3272	700042150H1	SATMON004	g217963	BLASTN	1186	1e-108	99
26	3272	700045728H1	SATMON004	g217963	BLASTN	1313	1e-108	96
27	3272	700098561H1	SATMON009	g217963	BLASTN	1236	1e-107	96
28	3272	700100271H1	SATMON009	g217963	BLASTN	1392	1e-107	93
29	3272	700211770H1	SATMON016	g217963	BLASTN	1097	1e-105	97
30	3272	700095614H1	SATMON008	g217963	BLASTN	1366	1e-105	91
31	3272	700577012H1	SATMON031	g217963	BLASTN	1348	1e-104	97
32	3272	700100637H1	SATMON009	g217963	BLASTN	1357	1e-104	97
33	3272	700045636H1	SATMON004	g217963	BLASTN	1240	1e-103	100
34	3272	700210942H1	SATMON016	g217963	BLASTN	1183	1e-102	97
35	3272	700213737H1	SATMON016	g217963	BLASTN	1286	1e-102	96
36	3272	700097664H1	SATMON009	g1673455	BLASTN	1093	1e-101	99
37	3272	700212658H1	SATMON016	g217963	BLASTN	1312	1e-101	97
38	3272	700101672H1	SATMON009	g217963	BLASTN	1313	1e-101	97
39	3272	700053379H1	SATMON009	g217963	BLASTN	1315	1e-101	95
40	3272	700025653H1	SATMON004	g217963	BLASTN	1316	1e-101	99
41	3272	700333193H1	SATMON019	g217963	BLASTN	1318	1e-101	97
42	3272	700211830H1	SATMON016	g217963	BLASTN	1042	1e-100	94
43	3272	700097362H1	SATMON009	g217963	BLASTN	1300	1e-100	93
44	3272	700214096H1	SATMON016	g217963	BLASTN	1308	1e-100	97
45	3272	700042186H1	SATMON004	g217963	BLASTN	1287	1e-99	97
46	3272	700097564H1	SATMON009	g217963	BLASTN	1293	1e-99	92
47	3272	700097886H1	SATMON009	g217963	BLASTN	1232	1e-98	97
48	3272	700043286H1	SATMON004	g217963	BLASTN	1281	1e-98	99



103	3272	700043871H1	SATMON004	g217963	BLASTN	880	1e-64	92
104	3272	700429382H1	SATMONN01	g529673	BLASTN	440	1e-63	92
105	3272	700442416H1	SATMON026	g217963	BLASTN	603	1e-60	88
106	3272	700208826H1	SATMON016	g217963	BLASTN	379	1e-59	98
107	3272	700209462H1	SATMON016	g22464	BLASTN	796	1e-59	95
108	3272	700209449H1	SATMON016	g1673455	BLASTN	609	1e-53	94
109	3272	700354501H1	SATMON024	g217963	BLASTN	644	1e-52	94
110	3272	700099672H1	SATMON009	g22464	BLASTN	648	1e-45	95
111	3272	700216452H1	SATMON016	g529673	BLASTN	550	1e-37	84
112	3272	700097732H1	SATMON009	g1673455	BLASTN	453	1e-28	98
113	3272	700334324H1	SATMON019	g1673455	BLASTN	434	1e-27	97
114	8171	700098206H1	SATMON009	g1673455	BLASTN	711	1e-105	94
115	8171	700443785H1	SATMON027	g1673455	BLASTN	727	1e-97	97
116	8171	700444325H1	SATMON027	g1673455	BLASTN	1091	1e-82	98
117	8171	700096125H1	SATMON008	g1673455	BLASTN	749	1e-64	92
118	8171	700447385H1	SATMON027	g1673455	BLASTN	601	1e-54	88
119	8171	700101184H1	SATMON009	g1673455	BLASTN	613	1e-52	90
120	8171	700042451H1	SATMON004	g1673455	BLASTN	507	1e-43	94
121	-L1892710	LIB189-012-Q1-E1-F5	LIB189	g18035	BLASTN	745	1e-53	87
122	-L1893905	LIB189-022-Q1-E1-A5	LIB189	g1040912	BLASTN	1259	1e-96	84
123	-L30601614	LIB3060-004-Q1-K1-D4	LIB3060	g12394	BLASTN	497	1e-47	90
124	-L30601698	LIB3060-005-Q1-K1-A3	LIB3060	g12394	BLASTN	813	1e-82	90
125	-L30604185	LIB3060-040-Q1-K1-G6	LIB3060	g22464	BLASTN	508	1e-46	83
126	-L30605233	LIB3060-050-Q1-K1-E5	LIB3060	g18035	BLASTN	425	1e-43	84
127	-L30623478	LIB3062-029-Q1-K1-F9	LIB3062	g22464	BLASTN	260	1e-27	81
128	-L30624113	LIB3062-015-Q1-K1-E9	LIB3062	g1673455	BLASTN	264	1e-39	83
129	-L30626076	LIB3062-057-Q1-K1-G7	LIB3062	g217963	BLASTN	332	1e-18	85
130	-L30673250	LIB3067-018-Q1-K1-F10	LIB3067	g18035	BLASTN	1123	1e-100	81
131	-L30681922	LIB3068-020-Q1-K1-A6	LIB3068	g1040894	BLASTN	1180	1e-106	86
132	-L30686213	LIB3068-050-Q1-K1-B9	LIB3068	g18035	BLASTN	1402	1e-108	96
133	-L30686456	LIB3068-016-Q1-K1-D3	LIB3068	g11750	BLASTN	337	1e-90	84
134	-L30781756	LIB3078-015-Q1-K1-A3	LIB3078	g1673455	BLASTN	296	1e-31	82
135	-L30782307	LIB3078-006-Q1-K1-A3	LIB3078	g217963	BLASTN	313	1e-17	84
136	-L30782348	LIB3078-006-Q1-K1-C8	LIB3078	g217964	BLASTX	64	1e-26	44
137	-L30783621	LIB3078-053-Q1-K1-B1	LIB3078	g217963	BLASTN	461	1e-39	69
138	-L30784234	LIB3078-034-Q1-K1-C1	LIB3078	g217963	BLASTN	288	1e-30	84

139	-L30784545	LIB3078-039-Q1-K1-H12	LIB3078	g18035	BLASTN	944	1e-96	88
140	-L361484	LIB36-008-Q1-E1-E1	LIB36	g217963	BLASTN	683	1e-58	92
141	-L361797	LIB36-020-Q1-E1-H9	LIB36	g12394	BLASTN	290	1e-32	76
142	-L362703	LIB36-018-Q1-E1-D9	LIB36	g1040892	BLASTN	1253	1e-95	90
143	-L84236	LIB84-004-Q1-E1-A2	LIB84	g217963	BLASTN	322	1e-50	81
144	-L84828	LIB84-015-Q1-E1-B4	LIB84	g18035	BLASTN	473	1e-36	86
145	24099	LIB36-014-Q1-E1-C4	LIB36	g18035	BLASTN	2297	1e-183	99
146	24099	LIB36-014-Q1-E1-B6	LIB36	g18035	BLASTN	2294	1e-182	99
147	24099	LIB3068-005-Q1-K1-B1	LIB3068	g18035	BLASTN	2188	1e-179	93
148	24099	LIB3066-053-Q1-K1-H3	LIB3066	g18035	BLASTN	2252	1e-179	97
149	24099	LIB36-016-Q2-E2-F11	LIB36	g18035	BLASTN	1369	1e-176	99
150	24099	LIB3068-022-Q1-K1-C10	LIB3068	g18035	BLASTN	2209	1e-175	98
151	24099	LIB3078-007-Q1-K1-B11	LIB3078	g18035	BLASTN	2004	1e-172	99
152	24099	LIB3078-049-Q1-K1-A1	LIB3078	g18035	BLASTN	2154	1e-171	98
153	24099	LIB3060-016-Q1-K1-C8	LIB3060	g18035	BLASTN	2151	1e-170	99
154	24099	LIB189-012-Q1-E1-F10	LIB189	g18035	BLASTN	2132	1e-169	98
155	24099	LIB3078-049-Q1-K1-G3	LIB3078	g18035	BLASTN	2136	1e-169	99
156	24099	LIB3060-025-Q1-K1-H1	LIB3060	g18035	BLASTN	1587	1e-167	99
157	24099	LIB3060-016-Q1-K1-D2	LIB3060	g18035	BLASTN	2112	1e-167	98
158	24099	LIB189-029-Q1-E1-H11	LIB189	g18035	BLASTN	1942	1e-166	98
159	24099	LIB36-021-Q1-E1-H9	LIB36	g18035	BLASTN	2096	1e-166	99
160	24099	LIB84-008-Q1-E1-G8	LIB84	g18035	BLASTN	2090	1e-165	100
161	24099	LIB36-021-Q1-E1-B7	LIB36	g18035	BLASTN	1923	1e-164	98
162	24099	LIB189-016-Q1-E1-A3	LIB189	g18035	BLASTN	2070	1e-164	97
163	24099	LIB3060-052-Q1-K1-B5	LIB3060	g18035	BLASTN	1634	1e-163	95
164	24099	LIB3078-023-Q1-K1-F3	LIB3078	g18035	BLASTN	1659	1e-163	95
165	24099	LIB3066-005-Q1-K1-D11	LIB3066	g18035	BLASTN	1819	1e-163	97

166	24099	LIB189-023-Q1-E1-H10	LIB189	g18035	BLASTN	1697	1e-161	96
167	24099	LIB189-004-Q1-E1-B6	LIB189	g18035	BLASTN	1705	1e-161	92
168	24099	LIB3078-018-Q1-K1-F2	LIB3078	g18035	BLASTN	1748	1e-161	98
169	24099	LIB3066-003-Q1-K1-F3	LIB3066	g18035	BLASTN	2034	1e-160	96
170	24099	LIB3062-053-Q1-K1-D2	LIB3062	g18035	BLASTN	1761	1e-159	96
171	24099	LIB3069-017-Q1-K1-E6	LIB3069	g11750	BLASTN	1144	1e-157	95
172	24099	LIB3078-054-Q1-K1-H4	LIB3078	g18035	BLASTN	1980	1e-156	95
173	24099	LIB3060-036-Q1-K1-F5	LIB3060	g18035	BLASTN	1960	1e-154	96
174	24099	LIB3078-014-Q1-K1-E11	LIB3078	g18035	BLASTN	1961	1e-154	99
175	24099	LIB3066-015-Q1-K1-D8	LIB3066	g18035	BLASTN	1526	1e-152	96
176	24099	LIB3068-016-Q1-K1-D2	LIB3068	g18035	BLASTN	1925	1e-151	91
177	24099	LIB189-011-Q1-E1-F8	LIB189	g1040894	BLASTN	1675	1e-150	98
178	24099	LIB3060-002-Q1-K2-B4	LIB3060	g1040894	BLASTN	1578	1e-149	97
179	24099	LIB3078-004-Q1-K1-G9	LIB3078	g1040912	BLASTN	1609	1e-149	94
180	24099	LIB189-031-Q1-E1-A5	LIB189	g18035	BLASTN	1775	1e-149	98
181	24099	LIB36-019-Q1-E1-F7	LIB36	g18035	BLASTN	1718	1e-146	97
182	24099	LIB84-030-Q1-E1-G10	LIB84	g1040894	BLASTN	1822	1e-146	98
183	24099	LIB3062-031-Q1-K1-A10	LIB3062	g18035	BLASTN	791	1e-145	93
184	24099	LIB3078-014-Q1-K1-E2	LIB3078	g18035	BLASTN	1817	1e-142	98
185	24099	LIB189-020-Q1-E1-G2	LIB189	g1040892	BLASTN	1660	1e-140	96
186	24099	LIB189-003-Q1-E1-G6	LIB189	g18035	BLASTN	1774	1e-139	97
187	24099	LIB3060-009-Q1-K1-F8	LIB3060	g18035	BLASTN	1240	1e-138	96
188	24099	LIB3078-011-Q1-K1-C10	LIB3078	g18035	BLASTN	1771	1e-138	91
189	24099	LIB3066-027-Q1-K1-H12	LIB3066	g11750	BLASTN	1289	1e-133	94
190	24099	LIB84-005-Q1-E1-B4	LIB84	g18035	BLASTN	1137	1e-132	96
191	24099	LIB3078-027-Q1-K1-E11	LIB3078	g18035	BLASTN	1450	1e-131	99
192	24099	LIB36-016-Q2-E2-G10	LIB36	g18035	BLASTN	1661	1e-129	99

193	24099	LIB3060-020-Q1-K1-H7	LIB3060	g18035	BLASTN	1334	1e-126	96
194	24099	LIB3068-045-Q1-K1-F6	LIB3068	g11750	BLASTN	1349	1e-126	91
195	24099	LIB3060-048-Q1-K1-C5	LIB3060	g18035	BLASTN	1517	1e-126	90
196	24099	LIB3078-028-Q1-K1-G7	LIB3078	g1040912	BLASTN	1094	1e-125	96
197	24099	LIB3078-008-Q1-K1-F7	LIB3078	g18035	BLASTN	1282	1e-122	83
198	24099	LIB3078-035-Q1-K1-H4	LIB3078	g1040892	BLASTN	1194	1e-118	81
199	24099	LIB36-015-Q1-E1-E1	LIB36	g18035	BLASTN	1508	1e-116	98
200	24099	LIB3060-029-Q1-K1-E10	LIB3060	g1040894	BLASTN	1400	1e-112	95
201	24099	LIB3060-038-Q1-K1-B8	LIB3060	g18035	BLASTN	1356	1e-104	97
202	24099	LIB189-026-Q1-E1-D9	LIB189	g18035	BLASTN	1319	1e-101	93
203	24099	LIB189-034-Q1-E1-D10	LIB189	g18035	BLASTN	748	1e-97	89
204	24099	LIB189-023-Q1-E1-F3	LIB189	g18035	BLASTN	635	1e-86	93
205	24099	LIB83-001-Q1-E1-E9	LIB83	g18035	BLASTN	540	1e-68	99
206	24099	LIB189-021-Q1-E1-D6	LIB189	g18035	BLASTN	715	1e-50	100
207	24207	LIB3060-026-Q1-K1-C3	LIB3060	g11797	BLASTN	694	1e-149	90
208	24207	LIB189-018-Q1-E1-E9	LIB189	g11797	BLASTN	904	1e-143	96
209	24207	LIB3060-020-Q1-K1-A10	LIB3060	g11797	BLASTN	694	1e-115	91
210	3272	LIB3078-018-Q1-K1-H8	LIB3078	g217963	BLASTN	2129	1e-180	97
211	3272	LIB36-009-Q1-E1-E12	LIB36	g217963	BLASTN	2057	1e-178	95
212	3272	LIB3078-013-Q1-K1-H11	LIB3078	g217963	BLASTN	2154	1e-173	99
213	3272	LIB83-007-Q1-E1-C9	LIB83	g217963	BLASTN	2008	1e-172	97
214	3272	LIB36-014-Q1-E1-H9	LIB36	g217963	BLASTN	1905	1e-171	99
215	3272	LIB3066-002-Q1-K1-B12	LIB3066	g217963	BLASTN	1962	1e-170	96
216	3272	LIB3062-036-Q1-K1-F11	LIB3062	g217963	BLASTN	2115	1e-170	97
217	3272	LIB36-007-Q1-E1-G2	LIB36	g217963	BLASTN	1985	1e-169	95
218	3272	LIB3078-006-Q1-K1-C7	LIB3078	g217963	BLASTN	1876	1e-168	97
219	3272	LIB3078-034-Q1-K1-B7	LIB3078	g217963	BLASTN	1786	1e-165	98

220	3272	LIB36-009-Q1-E1-H2	LIB36	g217963	BLASTN	1921	1e-165	95
221	3272	LIB36-020-Q1-E1-F10	LIB36	g217963	BLASTN	1717	1e-164	92
222	3272	LIB3078-053-Q1-K1-D9	LIB3078	g217963	BLASTN	1874	1e-162	97
223	3272	LIB83-015-Q1-E1-B8	LIB83	g217963	BLASTN	1876	1e-161	91
224	3272	LIB36-004-Q1-E1-D2	LIB36	g217963	BLASTN	1429	1e-160	97
225	3272	LIB83-011-Q1-E1-H7	LIB83	g217963	BLASTN	1557	1e-160	95
226	3272	LIB3078-018-Q1-K1-H1	LIB3078	g217963	BLASTN	1844	1e-159	88
227	3272	LIB189-030-Q1-E1-E9	LIB189	g217963	BLASTN	1436	1e-152	97
228	3272	LIB189-006-Q1-E1-F9	LIB189	g217963	BLASTN	1825	1e-151	99
229	3272	LIB36-022-Q1-E1-H3	LIB36	g217963	BLASTN	1635	1e-150	97
230	3272	LIB83-011-Q1-E1-D3	LIB83	g217963	BLASTN	1414	1e-149	97
231	3272	LIB3062-047-Q1-K1-B2	LIB3062	g217963	BLASTN	1691	1e-148	89
232	3272	LIB36-016-Q2-E2-D9	LIB36	g217963	BLASTN	1719	1e-147	93
233	3272	LIB36-021-Q1-E1-G3	LIB36	g217963	BLASTN	1512	1e-144	93
234	3272	LIB3078-004-Q1-K1-B4	LIB3078	g217963	BLASTN	1787	1e-142	96
235	3272	LIB3068-056-Q1-K1-C6	LIB3068	g217963	BLASTN	1145	1e-141	91
236	3272	LIB3078-052-Q1-K1-F8	LIB3078	g217963	BLASTN	1340	1e-141	96
237	3272	LIB36-021-Q1-E1-A6	LIB36	g217963	BLASTN	1436	1e-139	93
238	3272	LIB189-028-Q1-E1-B12	LIB189	g217963	BLASTN	1617	1e-139	98
239	3272	LIB83-005-Q1-E1-B3	LIB83	g217963	BLASTN	1495	1e-133	92
240	3272	LIB3060-020-Q1-K1-G10	LIB3060	g217963	BLASTN	750	1e-132	88
241	3272	LIB36-013-Q1-E1-E6	LIB36	g217963	BLASTN	1367	1e-132	90
242	3272	LIB84-015-Q1-E1-E1	LIB84	g217963	BLASTN	1545	1e-132	92
243	3272	LIB36-006-Q1-E1-E10	LIB36	g217963	BLASTN	1640	1e-130	91
244	3272	LIB84-027-Q1-E1-H12	LIB84	g217963	BLASTN	1333	1e-128	95
245	3272	LIB3067-001-Q1-K1-B11	LIB3067	g217963	BLASTN	1364	1e-127	90
246	3272	LIB3062-016-Q1-K1-D11	LIB3062	g217963	BLASTN	1369	1e-127	89



247	3272	LIB3060-013-Q1-K1-D6	LIB3060	g217963	BLASTN	1607	1e-127	90
248	3272	LIB3078-028-Q1-K1-F4	LIB3078	g217963	BLASTN	906	1e-126	93
249	3272	LIB3067-027-Q1-K1-A8	LIB3067	g217963	BLASTN	1364	1e-125	92
250	3272	LIB189-034-Q1-E1-B9	LIB189	g217963	BLASTN	1139	1e-117	91
251	3272	LIB189-027-Q1-E1-C2	LIB189	g217963	BLASTN	1264	1e-116	85
252	3272	LIB3060-034-Q1-K1-E7	LIB3060	g217963	BLASTN	1490	1e-116	86
253	3272	LIB36-010-Q1-E1-A10	LIB36	g217963	BLASTN	1427	1e-115	88
254	3272	LIB3078-040-Q1-K1-E5	LIB3078	g217963	BLASTN	1475	1e-115	84
255	3272	LIB3078-052-Q1-K1-H4	LIB3078	g22464	BLASTN	1141	1e-113	92
256	3272	LIB3078-001-Q1-K1-B1	LIB3078	g217963	BLASTN	1173	1e-113	93
257	3272	LIB84-017-Q1-E1-D1	LIB84	g1673455	BLASTN	747	1e-112	91
258	3272	LIB3060-034-Q1-K1-B7	LIB3060	g217963	BLASTN	1135	1e-112	87
259	3272	LIB3060-028-Q1-K1-D3	LIB3060	g217963	BLASTN	1012	1e-111	88
260	3272	LIB36-017-Q1-E1-B8	LIB36	g217963	BLASTN	1398	1e-108	87
261	3272	LIB84-008-Q1-E1-G1	LIB84	g217963	BLASTN	964	1e-103	93
262	3272	LIB3078-027-Q1-K1-D12	LIB3078	g217963	BLASTN	894	1e-100	91
263	3272	LIB36-010-Q1-E1-E7	LIB36	g217963	BLASTN	1257	1e-100	92
264	3272	LIB3068-029-Q1-K1-F6	LIB3068	g217963	BLASTN	1044	1e-93	94
265	3272	LIB3060-014-Q1-K1-D9	LIB3060	g217963	BLASTN	934	1e-89	92
266	3272	LIB3060-023-Q1-K1-H3	LIB3060	g1673455	BLASTN	666	1e-88	96
267	3272	LIB84-023-Q1-E1-B2	LIB84	g1673455	BLASTN	947	1e-84	91
268	3272	LIB3062-015-Q1-K1-H5	LIB3062	g217963	BLASTN	1007	1e-75	95
269	3272	LIB36-013-Q1-E1-H2	LIB36	g1673455	BLASTN	976	1e-72	97
270	3272	LIB36-009-Q1-E1-F4	LIB36	g22464	BLASTN	881	1e-63	98
271	3272	46-LIB84-007-Q1-E1-D6	LIB84	g22464	BLASTN	449	1e-38	95
272	3272	LIB3078-054-Q1-K1-D12	LIB3078	g529673	BLASTN	349	1e-24	94
273	3272	LIB36-016-Q2-E2-D1	LIB36	g529673	BLASTN	342	1e-19	97

274	8171	LIB3066-019-Q1-K1-H5	LIB3066	g1673455	BLASTN	1193	1e-161	95
275	8171	LIB36-005-Q1-E1-C10	LIB36	g1673455	BLASTN	1260	1e-155	99
276	8171	LIB84-008-Q1-E1-E11	LIB84	g1673455	BLASTN	1300	1e-150	100
277	8171	LIB36-010-Q1-E1-B4	LIB36	g1673455	BLASTN	1484	1e-125	99
278	8171	LIB36-017-Q1-E1-D2	LIB36	g1673455	BLASTN	1206	1e-113	98
279	8171	LIB83-005-Q1-E1-B2	LIB83	g1673455	BLASTN	620	1e-85	93
280	8171	LIB36-022-Q1-E1-E3	LIB36	g1673455	BLASTN	729	1e-60	95
281	8171	LIB84-006-Q1-E1-B2	LIB84	g1673455	BLASTN	298	1e-15	67

# SOYBEAN RIBULOSE-BISPHOSPHATE CARBOXYLASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
282	-700646133	700646133H1	SOYMON012	g1079735	BLASTN	249	1e-11	77
283	-700680902	700680902H1	SOYMON008	g1055367	BLASTN	454	1e-46	87
284	-700737728	700737728H1	SOYMON012	g1055367	BLASTN	241	1e-18	91
285	-700873832	700873832H1	SOYMON018	g1055367	BLASTN	424	1e-26	88
286	-700874452	700874452H1	SOYMON018	g1079735	BLASTN	209	1e-8	87
287	-700993404	700993404H1	SOYMON011	g1055367	BLASTN	508	1e-70	87
288	-700995052	700995052H1	SOYMON011	g1079735	BLASTN	235	1e-10	91
289	-701118676	701118676H1	SOYMON037	g1055367	BLASTN	427	1e-44	78
290	10981	700661710H1	SOYMON005	g3168587	BLASTX	194	1e-20	57
291	10981	700661109H1	SOYMON005	g3168587	BLASTX	128	1e-10	51
292	16	700680726H1	SOYMON008	g1055367	BLASTN	1262	1e-126	98
293	16	700680952H1	SOYMON008	g1055367	BLASTN	1362	1e-126	93
294	16	700680959H1	SOYMON008	g1055367	BLASTN	1151	1e-120	98
295	16	700763859H1	SOYMON018	g1055367	BLASTN	1472	1e-116	99
296	16	700557838H1	SOYMON001	g1055367	BLASTN	1456	1e-115	99
297	16	700558916H1	SOYMON001	g1055367	BLASTN	1441	1e-113	99
298	16	700680502H1	SOYMON008	g1055367	BLASTN	665	1e-112	96
299	16	700556877H1	SOYMON001	g1079735	BLASTN	743	1e-109	96
300	16	700606206H1	SOYMON008	g1055367	BLASTN	770	1e-109	100
301	16	700557609H1	SOYMON001	g1055367	BLASTN	1085	1e-109	99
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306	16	700605320H2	SOYMON004	g1055367	BLASTN	1389	1e-108	99
307	16	700563581H1	SOYMON002	g1055367	BLASTN	1379	1e-107	98
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322	16	700555221H1	SOYMON001	g1055367	BLASTN	1351	1e-104	99
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351	16	700788520H1	SOYMON011	g1055367	BLASTN	1304	1e-100	97
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478	16	701104761H1	SOYMON036	g1055367	BLASTN	1133	1e-92	93
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492	16	701108362H1	SOYMON036	g1055367	BLASTN	1129	1e-91	95
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496	16	700683005H1	SOYMON008	g1055367	BLASTN	1159	1e-91	98
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511	16	701002369H1	SOYMON018	g1055367	BLASTN	953	1e-90	99
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533	16	701107017H1	SOYMON036	g1055367	BLASTN	617	1e-88	96
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596	16	700743222H1	SOYMON012	g1055367	BLASTN	874	1e-83	98
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639	16	700791542H1	SOYMON011	g1055367	BLASTN	625	1e-77	97



640	16	700682942H1	SOYMON008	g1055367	BLASTN	683	1e-77	98
641	16	700994722H1	SOYMON011	g1055367	BLASTN	801	1e-77	93
642	16	700788601H1	SOYMON011	g1055367	BLASTN	1036	1e-77	99
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668	16	700656924H1	SOYMON004	g1055367	BLASTN	361	1e-69	88
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672	16	700741463H1	SOYMON012	g1055367	BLASTN	537	1e-67	87
673	16	700870507H1	SOYMON018	g1055367	BLASTN	566	1e-67	94
674	16	701123032H1	SOYMON037	g1055367	BLASTN	687	1e-67	85
675	16	700946185H1	SOYMON024	g1055367	BLASTN	862	1e-67	96
676	16	700994265H1	SOYMON011	g1055367	BLASTN	907	1e-67	86
677	16	700742553H1	SOYMON012	g1055367	BLASTN	626	1e-66	98
678	16	700655130H1	SOYMON004	g1055367	BLASTN	895	1e-66	80
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696	16	700742875H1	SOYMON012	g1055367	BLASTN	758	1e-54	93
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700	16	700902134H1	SOYMON027	g1055367	BLASTN	711	1e-50	99
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708	16	700991810H1	SOYMON011	g1055367	BLASTN	377	1e-44	92
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713	16	700743017H1	SOYMON012	g170057	BLASTN	349	1e-40	89
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716	16	700790942H1	SOYMON011	g170057	BLASTN	597	1e-40	86
717	16	700902452H1	SOYMON027	g1079735	BLASTN	395	1e-39	96
718	16	700658005H1	SOYMON004	g1079735	BLASTN	575	1e-39	100
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728	16	700742728H1	SOYMON012	g1055367	BLASTN	482	1e-31	94
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730	16	700874150H1	SOYMON018	g18754	BLASTN	340	1e-30	93
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733	16	700989477H1	SOYMON011	g1055367	BLASTN	358	1e-26	98
734	16	700790532H2	SOYMON011	g1055367	BLASTN	330	1e-24	99
735	16	700895830H1	SOYMON027	g1055367	BLASTN	286	1e-23	96
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738	16	700895956H1	SOYMON027	g1055367	BLASTN	193	1e-19	97
739	16	700680886H1	SOYMON008	g1055367	BLASTN	230	1e-17	82
740	16	700738267H1	SOYMON012	g1055367	BLASTN	246	1e-15	99
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742	16	700657321H1	SOYMON004	g1536889	BLASTX	92	1e-11	88
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744	16	700789463H2	SOYMON011	g1055367	BLASTN	159	1e-8	89
745	317	700998406H1	SOYMON018	g2323417	BLASTN	258	1e-33	80
746	317	700733345H1	SOYMON010	g2323461	BLASTN	292	1e-33	85
747	317	700681456H2	SOYMON008	g2323417	BLASTN	239	1e-23	79

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752	-GM30860	LIB3050-005-Q1-K1-D5	LIB3050	g21049	BLASTN	262	1e-21	68
753	-GM45237	LIB3073-001-Q1-K1-F7	LIB3073	g1055367	BLASTN	570	1e-38	64
754	-GM45275	LIB3073-001-Q1-K1-H6	LIB3073	g170057	BLASTN	665	1e-90	83
755	-GM45440	LIB3073-023-Q1-K1-A11	LIB3073	g1055367	BLASTN	906	1e-66	76
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757	16	LIB3073-023-Q1-K1-C6	LIB3073	g1055367	BLASTN	2074	1e-166	98
758	16	LIB3073-013-Q1-K1-A5	LIB3073	g1055367	BLASTN	2057	1e-165	99
759	16	LIB3055-007-Q1-N1-E4	LIB3055	g1055367	BLASTN	2065	1e-165	99
760	16	LIB3055-009-Q1-N1-A9	LIB3055	g1055367	BLASTN	2067	1e-165	98
761	16	LIB3055-008-Q1-N1-C9	LIB3055	g1055367	BLASTN	2047	1e-164	99
762	16	LIB3030-009-Q1-B1-G2	LIB3030	g1055367	BLASTN	823	1e-163	96
763	16	LIB3040-002-Q1-E1-A4	LIB3040	g1055367	BLASTN	1623	1e-163	97
764	16	LIB3073-023-Q1-K1-E8	LIB3073	g1055367	BLASTN	1671	1e-163	96
765	16	LIB3073-006-Q1-K1-E8	LIB3073	g1055367	BLASTN	2040	1e-163	100
766	16	LIB3053-010-Q1-N1-E7	LIB3053	g1055367	BLASTN	2023	1e-162	99
767	16	LIB3073-024-Q1-K1-H4	LIB3073	g1055367	BLASTN	1608	1e-161	99
768	16	LIB3055-008-Q1-N1-A7	LIB3055	g1055367	BLASTN	2008	1e-161	97
769	16	LIB3073-001-Q1-K1-B10	LIB3073	g1055367	BLASTN	1078	1e-160	98
770	16	LIB3055-013-Q1-N1-B2	LIB3055	g1055367	BLASTN	1726	1e-160	96
771	16	LIB3073-002-Q1-K1-C1	LIB3073	g1055367	BLASTN	1728	1e-160	96
772	16	LIB3073-013-Q1-K1-F11	LIB3073	g1055367	BLASTN	1904	1e-160	99
773	16	LIB3073-022-Q1-K1-A11	LIB3073	g1055367	BLASTN	1885	1e-159	100
774	16	LIB3073-026-Q1-K1-G9	LIB3073	g1055367	BLASTN	1987	1e-159	99
775	16	LIB3073-026-Q1-K1-G9	LIB3073	g1055367	BLASTN	1991	1e-159	99

776	16	LIB3073-024- Q1-K1-A10	LIB3073	g1055367	BLASTN	1740	1e-158	99
777	16	LIB3073-012- Q1-K1-D7	LIB3073	g1055367	BLASTN	1876	1e-158	98
778	16	LIB3049-013- Q1-E1-B3	LIB3049	g1055367	BLASTN	1265	1e-157	99
779	16	LIB3053-014- Q1-N1-F9	LIB3053	g1055367	BLASTN	1592	1e-157	97
780	16	LIB3054-003- Q1-N1-G12	LIB3054	g1055367	BLASTN	1949	1e-156	99
781	16	LIB3053-001- Q1-B1-B3	LIB3053	g1055367	BLASTN	1935	1e-155	100
782	16	LIB3027-005- Q1-B1-F12	LIB3027	g1055367	BLASTN	1943	1e-155	99
783	16	LIB3054-001- Q1-B1-E6	LIB3054	g1055367	BLASTN	1945	1e-155	100
784	16	LIB3055-007- Q1-N1-G11	LIB3055	g1055367	BLASTN	1691	1e-154	95
785	16	LIB3073-026- Q1-K1-D12	LIB3073	g1055367	BLASTN	1917	1e-153	99
786	16	LIB3053-009- Q1-N1-C6	LIB3053	g1055367	BLASTN	1919	1e-153	98
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788	16	LIB3073-006- Q1-K1-F6	LIB3073	g1055367	BLASTN	1789	1e-151	95
789	16	LIB3073-011- Q1-K1-A12	LIB3073	g1055367	BLASTN	647	1e-150	94
790	16	LIB3073-007- Q1-K1-B9	LIB3073	g1055367	BLASTN	1110	1e-150	98
791	16	LIB3055-005- Q1-N1-G4	LIB3055	g1055367	BLASTN	1877	1e-150	93
792	16	LIB3073-006- Q1-K1-F5	LIB3073	g1055367	BLASTN	1886	1e-150	99
793	16	LIB3073-022- Q1-K1-B9	LIB3073	g1055367	BLASTN	1765	1e-149	94
794	16	LIB3073-024- Q1-K1-F3	LIB3073	g1055367	BLASTN	1768	1e-149	95
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800	16	LIB3055-008- Q1-N1-E12	LIB3055	g1055367	BLASTN	1731	1e-146	93
801	16	LIB3073-001- Q1-K1-B7	LIB3073	g1055367	BLASTN	988	1e-145	97
802	16	LIB3039-004-	LIB3039	g1055367	BLASTN	1817	1e-145	98

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803	16	LIB3053-006-Q1-N1-D9	LIB3053	g1055367	BLASTN	1823	1e-145	95
804	16	LIB3039-021-Q1-E1-A3	LIB3039	g1055367	BLASTN	906	1e-143	96
805	16	LIB3053-001-Q1-B1-D4	LIB3053	g1055367	BLASTN	1367	1e-143	91
806	16	LIB3039-046-Q1-E1-E5	LIB3039	g1055367	BLASTN	1567	1e-143	99
807	16	LIB3073-007-Q1-K1-B2	LIB3073	g1055367	BLASTN	1392	1e-142	92
808	16	LIB3073-023-Q1-K1-C3	LIB3073	g1055367	BLASTN	1683	1e-142	88
809	16	LIB3055-002-Q1-B1-E1	LIB3055	g1055367	BLASTN	912	1e-141	90
810	16	LIB3073-025-Q1-K1-H8	LIB3073	g1055367	BLASTN	1769	1e-141	93
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812	16	LIB3055-008-Q1-N1-H4	LIB3055	g1055367	BLASTN	659	1e-140	93
813	16	LIB3054-011-Q1-N1-A1	LIB3054	g1055367	BLASTN	1384	1e-140	90
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816	16	LIB3053-002-Q1-B1-H2	LIB3053	g1055367	BLASTN	686	1e-139	94
817	16	LIB3073-013-Q1-K1-F6	LIB3073	g1055367	BLASTN	1590	1e-138	96
818	16	LIB3073-025-Q1-K1-B10	LIB3073	g1055367	BLASTN	1643	1e-138	94
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1006	66	700023196H1	SATMON003	g21834	BLASTN	738	1e-52	80
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1016	66	700612632H1	SATMON033	g21834	BLASTN	591	1e-45	91
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1022	66	700041618H1	SATMON004	g21834	BLASTN	627	1e-43	86

1023	66	70050511H1	SATMON003	g21834	BLASTN	618	1e-42	86
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1026	66	700440268H1	SATMON026	g21834	BLASTN	608	1e-41	86
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1028	66	700617741H1	SATMON033	g2982312	BLASTN	402	1e-40	77
1029	66	700578506H1	SATMON031	g21834	BLASTN	580	1e-39	82
1030	66	700618491H2	SATMON033	g21834	BLASTN	591	1e-39	85
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1032	66	700195008H1	SATMON014	g21834	BLASTN	559	1e-37	80
1033	66	700257337H1	SATMON017	g21834	BLASTN	463	1e-35	90
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1038	66	700804078H1	SATMON036	g21834	BLASTN	491	1e-32	83
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1040	66	701165809H1	SATMONN04	g21834	BLASTN	279	1e-26	83
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1043	66	700450825H1	SATMON028	g21834	BLASTN	240	1e-16	90
1044	66	700334736H1	SATMON019	g1161602	BLASTX	126	1e-14	76
1045	66	700202264H1	SATMON003	g21834	BLASTN	214	1e-14	92
1046	66	700583352H1	SATMON031	g1161602	BLASTX	117	1e-9	100
1047	66	700802543H1	SATMON036	g21834	BLASTN	233	1e-9	94
1048	66	700018689H1	SATMON001	g3309631	BLASTX	103	1e-8	89
1049	-L30621557	LIB3062-018-Q1-K1-F2	LIB3062	g313266	BLASTN	776	1e-60	79
1050	-L30624706	LIB3062-049-Q1-K1-H7	LIB3062	g21832	BLASTN	906	1e-102	79
1051	-L30672623	LIB3067-004-Q1-K1-A5	LIB3067	g21834	BLASTN	571	1e-38	89
1052	16294	LIB3078-050-Q1-K1-D12	LIB3078	g21832	BLASTN	747	1e-60	83
1053	16294	LIB3078-049-Q1-K1-H7	LIB3078	g21832	BLASTN	207	1e-14	84
1054	2232	LIB3078-002-Q1-K1-C4	LIB3078	g21832	BLASTN	1606	1e-125	87
1055	2232	LIB36-001-Q1-E1-B11	LIB36	g21832	BLASTN	1293	1e-123	84
1056	2232	LIB36-009-Q1-E1-G7	LIB36	g21832	BLASTN	1591	1e-123	88
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1058	2232	LIB36-008-Q1-E1-H5	LIB36	g21832	BLASTN	1340	1e-110	84
1059	2232	LIB3078-014-Q1-K1-F7	LIB3078	g21832	BLASTN	1422	1e-109	86
1060	2232	LIB36-017-Q1-E1-D8	LIB36	g21832	BLASTN	1230	1e-99	84
1061	2232	LIB3078-052-Q1-K1-F3	LIB3078	g21832	BLASTN	1045	1e-96	79
1062	2232	11-LIB189-015-Q1-E1-	LIB189	g21832	BLASTN	912	1e-72	81

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1064	66	LIB3060-012-Q1-K1-H11	LIB3060	g21834	BLASTN	1691	1e-132	87
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1066	66	LIB3059-047-Q1-K1-A8	LIB3059	g21834	BLASTN	1338	1e-115	92
1067	66	LIB189-027-Q1-E1-D10	LIB189	g21834	BLASTN	1485	1e-115	88
1068	66	LIB83-006-Q1-E1-F2	LIB83	g21834	BLASTN	1148	1e-114	80
1069	66	LIB3060-017-Q1-K1-G5	LIB3060	g21834	BLASTN	1187	1e-113	79
1070	66	LIB143-011-Q1-E1-B6	LIB143	g21834	BLASTN	1412	1e-113	93
1071	66	LIB3059-006-Q1-K1-A4	LIB3059	g21834	BLASTN	1452	1e-112	82
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1073	66	LIB3059-041-Q1-K1-D2	LIB3059	g21834	BLASTN	1441	1e-111	82
1074	66	LIB3079-002-Q1-K1-H3	LIB3079	g21834	BLASTN	977	1e-101	85
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1081	66	LIB3067-046-Q1-K1-A9	LIB3067	g21834	BLASTN	967	1e-82	75
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1085	66	LIB143-068-Q1-E1-H4	LIB143	g21834	BLASTN	879	1e-67	90
1086	66	LIB3069-052-Q1-K1-E12	LIB3069	g21834	BLASTN	843	1e-65	93
1087	66	LIB3059-012-Q1-K1-B7	LIB3059	g21834	BLASTN	611	1e-62	82
1088	66	LIB3078-056-Q1-K1-D5	LIB3078	g1161601	BLASTN	467	1e-58	77
1089	66	LIB3062-035-	LIB3062	g21834	BLASTN	320	1e-47	81

1090 66 Q1-K1-H2  
LIB3069-045- LIB3069 g21834 BLASTN 627 1e-41 86  
Q1-K1-D11

SOYBEAN PHOSPHOGLYCERATE KINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
1091	-700561750	700561750H1	SOYMON002	g1161602	BLASTX	98	1e-16	90
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1093	-700846548	700846548H1	SOYMON021	g21833	BLASTX	158	1e-14	83
1094	-700867263	700867263H1	SOYMON016	g1161602	BLASTX	132	1e-11	85
1095	-700989319	700989319H1	SOYMON011	g1022803	BLASTX	99	1e-15	72
1096	-700998533	700998533H1	SOYMON018	g2257597	BLASTN	406	1e-25	75
1097	-701104514	701104514H1	SOYMON036	g21272	BLASTX	169	1e-17	78
1098	-701108251	701108251H1	SOYMON036	g21271	BLASTN	561	1e-37	83
1099	16	701045420H1	SOYMON032	g2257597	BLASTN	937	1e-69	92
1100	16	700979939H1	SOYMON009	g21271	BLASTN	921	1e-67	82
1101	16	700962832H1	SOYMON022	g1022804	BLASTN	882	1e-64	82
1102	16	700648009H1	SOYMON003	g21271	BLASTN	859	1e-62	75
1103	16	700901512H1	SOYMON027	g1022804	BLASTN	840	1e-61	79
1104	16	701120901H1	SOYMON037	g21271	BLASTN	816	1e-59	76
1105	16	700731242H1	SOYMON009	g1022804	BLASTN	803	1e-58	80
1106	16	700995275H1	SOYMON011	g1022804	BLASTN	791	1e-57	84
1107	16	700566593H1	SOYMON002	g1161601	BLASTN	795	1e-57	75
1108	16	701152346H1	SOYMON031	g1161599	BLASTN	636	1e-56	78
1109	16	700999851H1	SOYMON018	g21271	BLASTN	769	1e-55	83
1110	16	700877067H1	SOYMON018	g1022804	BLASTN	774	1e-55	82
1111	16	700743313H1	SOYMON012	g1022804	BLASTN	765	1e-54	84
1112	16	700605425H2	SOYMON004	g1161601	BLASTN	747	1e-53	75
1113	16	700846107H1	SOYMON021	g1161601	BLASTN	750	1e-53	76
1114	16	700755167H1	SOYMON014	g1022804	BLASTN	730	1e-52	80
1115	16	700986996H1	SOYMON009	g21271	BLASTN	736	1e-52	73
1116	16	700873077H1	SOYMON018	g1161601	BLASTN	721	1e-51	75
1117	16	700995849H1	SOYMON011	g1161601	BLASTN	698	1e-49	76
1118	16	700754326H1	SOYMON014	g1022804	BLASTN	301	1e-48	84
1119	16	701063449H1	SOYMON033	g1161601	BLASTN	685	1e-48	75
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1124	16	701040938H1	SOYMON029	g1161601	BLASTN	637	1e-44	76
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1148	16	700742113H1	SOYMON012	g1022804	BLASTN	546	1e-36	85
1149	16	700754067H1	SOYMON014	g1161599	BLASTN	547	1e-36	76
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1160	16	700650261H1	SOYMON003	g1161601	BLASTN	535	1e-35	81
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1174	16	701156137H1	SOYMON031	g1161601	BLASTN	412	1e-30	81
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1192	16	701062162H1	SOYMON033	g1161599	BLASTN	255	1e-10	72
1193	1699	700560995H1	SOYMON001	g1022804	BLASTN	986	1e-73	82
1194	1699	700562380H1	SOYMON002	g1022804	BLASTN	954	1e-70	82
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1203	1699	700684389H1	SOYMON008	g3328121	BLASTN	834	1e-60	81
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1216	1699	700740204H1	SOYMON012	g3328121	BLASTN	730	1e-52	81
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1340	-700377496	700377496H1	SATMON019	g1184773	BLASTN	549	1e-70	93
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1632	325	700353680H1	SATMON024	g1184773	BLASTN	1171	1e-101	99
1633	325	700265106H1	SATMON017	g1184773	BLASTN	1292	1e-101	95
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1668	325	700550683H1	SATMON022	g1184771	BLASTN	1266	1e-99	99
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1674	325	700045668H1	SATMON004	g1184771	BLASTN	1297	1e-99	99
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1678	325	700444055H1	SATMON027	g1184771	BLASTN	1300	1e-99	100
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1688	325	700262781H1	SATMON017	g1184771	BLASTN	1016	1e-98	98
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1727	325	700381789H1	SATMON023	g1184773	BLASTN	1280	1e-97	93
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1749	325	700223241H1	SATMON011	g22237	BLASTN	1253	1e-95	99
1750	325	700382157H1	SATMON024	g1184773	BLASTN	125		



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1782	325	700214190H1	SATMON016	g1184771	BLASTN	1210	1e-92	100
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1784	325	700193816H1	SATMON014	g1184775	BLASTN	1212	1e-92	99
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1786	325	700160162H1	SATMON012	g1184775	BLASTN	1215	1e-92	98
1787	325	700171289H1	SATMON013	g22237	BLASTN	1220	1e-92	100
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1803	325	700457552H1	SATMON029	g1184771	BLASTN	953	1e-90	96
1804	325	700351671H1	SATMON023	g1184771	BLASTN	984	1e-90	9

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1817	325	700450090H2	SATMON028	g1184771	BLASTN	684	1e-88	93
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1820	325	700382823H1	SATMON024	g1184773	BLASTN	875	1e-88	96
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1856	325	700218841H1	SATMON011	g1184771	BLASTN	998	1e-85	93
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1877	325	700263853H1	SATMON017	g1184771	BLASTN	883	1e-82	95
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1885	325	700346309H1	SATMON021	g1184771	BLASTN	858	1e-81	92
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1895	325	700239677H1	SATMON010	g1184773	BLASTN	1066	1e-80	93
1896	325	700242889H1	SATMON010	g1184773	BLASTN	1066	1e-80	99
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1900	325	700047915H1	SATMON003	g1184771	BLASTN	724	1e-79	98
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1906	325	700613214H1	SATMON033	g1184771	BLASTN	997	1e-79	88
1907	325	700343710H1	SATMON021	g1184773	BLASTN	1055	1e-79	88
1908	325	700442421H1	SATMON026	g22237	BLASTN	501	1e-78	96
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1911	325	700551922H1	SATMON022	g22237	BLASTN	1045	1e-78	97
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1925	325	700238172H1	SATMON010	g1184771	BLASTN	1016	1e-75	99
1926	325	700349862H1	SATMON023	g22237	BLASTN	459	1e-74	96
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1928	325	700151243H1	SATMON007	g22237	BLASTN	994	1e-74	99
1929	325	700164181H1	SATMON013	g1184773	BLASTN	998	1e-74	98
1930	325	700149684H1	SATMON007	g1184773	BLASTN	999	1e-74	93
1931	325	700615060H1	SATMON033	g1184773	BLASTN	469	1e-73	90
1932	325	700456658H1	SATMON029	g1184771	BLASTN	580	1e-73	93
1933	325	700151426H1	SATMON007	g1184771	BLASTN	618	1e-73	100
1934	325	700261414H1	SATMON017	g1184771	BLASTN	709	1e-73	95
1935	325	700353168H1	SATMON024	g1184773	BLASTN	716	1e-73	91
1936	325	700350156H1	SATMON023	g1184771	BLASTN	757	1e-73	88
1937	325	700171133H1	SATMON013	g1184771	BLASTN	771	1e-73	94
1938	325	700150636H1	SATMON007	g1184771	BLASTN	771	1e-73	96
1939	325	700354231H1	SATMON024	g1184773	BLASTN	984	1e-73	98
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1942	325	700171506H1	SATMON013	g22237	BLASTN	847	1e-72	98
1943	325	700354944H1	SATMON024	g1184773	BLASTN	974	1e-72	93
1944	325	700160388H1	SATMON012	g1184773	BLASTN	974	1e-72	93
1945	325	700806125H1	SATMON036	g1184773	BLASTN	976	1e-72	87
1946	325	700072347H2	SATMON007	g1184773	BLASTN	962	1e-71	92
1947	325	700264638H1	SATMON017	g1185553	BLASTN	568	1e-70	95
1948	325	701181725H1	SATMONN06	g1184773	BLASTN	796	1e-70	91
1949	325	700439643H1	SATMON026	g1184771	BLASTN	885	1e-70	89
1950	325	700473276H1	SATMON025	g1184771	BLASTN	953	1e-70	99
1951	325	700335504H1	SATMON019	g1184773	BLASTN	597	1e-69	82
1952	325	700439983H1	SATMON026	g1184771	BLASTN	810	1e-69	99
1953	325	700803685H1	SATMON036	g1184773	BLASTN	825	1e-69	94
1954	325	700089572H1	SATMON011	g1184773	BLASTN	943	1e-69	99
1955	325	700620191H1	SATMON034	g1184771	BLASTN	838	1e-68	90
1956	325	700336318H1	SATMON019	g22237	BLASTN	930	1e-68	100
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1958	325	700471821H1	SATMON025	g1184771	BLASTN	590	1e-67	100
1959	325	700335407H1	SATMON019	g22237	BLASTN	912	1e-67	79
1960	325	700242905H1	SATMON010	g1184771	BLASTN	577	1e-66	93
1961	325	700333089H1	SATMON019	g1184773	BLASTN	760	1e-66	93
1962	325	700615210H1	SATMON033	g1184773	BLASTN	824	1e-66	93
1963	325	700197701H1	SATMON014	g1184773	BLASTN	901	1e-66	82
1964	325	700017877H1	SATMON001	g1184771	BLASTN	526	1e-64	93
1965	325	700467503H1	SATMON025	g293888	BLASTN	510	1e-63	94
1966	325	700457187H1	SATMON029	g1184771	BLASTN	648	1e-63	86
1967	325	700381477H1	SATMON023	g1184773	BLASTN	837	1e-63	98
1968	325	700614350H1	SATMON033	g22237	BLASTN	868	1e-63	96
1969	325	700092925H1	SATMON008	g22237	BLASTN	752	1e-62	94
1970	325	700016350H1	SATMON001	g22237	BLASTN	853	1e-62	98
1971	325	700019729H1	SATMON001	g22237	BLASTN	853	1e-62	98
1972	325	700167419H1	SATMON013	g1184771	BLASTN	860	1e-62	100
1973	325	700152703H1	SATMON007	g22237	BLASTN	860	1e-62	100
1974	325	700449337H1	SATMON028	g1184771	BLASTN	860	1e-62	100
1975	325	700151887H1	SATMON007	g1184775	BLASTN	848	1e-61	99
1976	325	700578028H1	SATMON031	g1184771	BLASTN	618	1e-60	91

1977	325	700440305H1	SATMON026	g1184771	BLASTN	660	1e-60	97
1978	325	700354945H1	SATMON024	g1184775	BLASTN	837	1e-60	98
1979	325	700341302H1	SATMON020	g1184771	BLASTN	375	1e-59	91
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1982	325	700446832H1	SATMON027	g1184771	BLASTN	802	1e-58	97
1983	325	700171562H1	SATMON013	g1184771	BLASTN	805	1e-58	100
1984	325	700156216H1	SATMON007	g1184773	BLASTN	779	1e-56	87
1985	325	700095551H1	SATMON008	g22237	BLASTN	779	1e-56	98
1986	325	701165479H1	SATMONN04	g1184771	BLASTN	786	1e-56	98
1987	325	700151917H1	SATMON007	g1184773	BLASTN	682	1e-55	90
1988	325	700153313H1	SATMON007	g22237	BLASTN	771	1e-55	99
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1990	325	700450961H1	SATMON028	g22237	BLASTN	480	1e-54	99
1991	325	700434230H1	SATMONN01	g1184771	BLASTN	765	1e-54	93
1992	325	700265994H1	SATMON017	g22237	BLASTN	748	1e-53	88
1993	325	700090231H1	SATMON011	g1184773	BLASTN	750	1e-53	100
1994	325	700073935H1	SATMON007	g1184773	BLASTN	751	1e-53	99
1995	325	700084392H1	SATMON011	g22237	BLASTN	640	1e-52	100
1996	325	700382560H1	SATMON024	g1184773	BLASTN	730	1e-52	81
1997	325	700257449H2	SATMON017	g1184771	BLASTN	555	1e-51	97
1998	325	700210766H1	SATMON016	g22237	BLASTN	723	1e-51	99
1999	325	700427913H1	SATMONN01	g22237	BLASTN	728	1e-51	98
2000	325	700351216H1	SATMON023	g1184771	BLASTN	550	1e-50	98
2001	325	700806073H1	SATMON036	g1184773	BLASTN	390	1e-49	79
2002	325	700207249H1	SATMON017	g1184771	BLASTN	480	1e-49	95
2003	325	700261719H1	SATMON017	g1184771	BLASTN	611	1e-49	94
2004	325	700430989H1	SATMONN01	g22237	BLASTN	631	1e-49	90
2005	325	700807308H1	SATMON036	g1184773	BLASTN	698	1e-49	86
2006	325	700334327H1	SATMON019	g1184771	BLASTN	704	1e-49	97
2007	325	700172805H1	SATMON013	g1184771	BLASTN	705	1e-49	95
2008	325	700422633H1	SATMONN01	g1184771	BLASTN	411	1e-47	89
2009	325	700353962H1	SATMON024	g1184773	BLASTN	678	1e-47	99
2010	325	701161133H1	SATMONN04	g1184771	BLASTN	655	1e-45	100
2011	325	700802550H1	SATMON036	g1184773	BLASTN	438	1e-44	92
2012	325	700440239H1	SATMON026	g22237	BLASTN	449	1e-44	95
2013	325	700454565H1	SATMON029	g1184771	BLASTN	524	1e-44	89
2014	325	700053528H1	SATMON010	g22237	BLASTN	635	1e-44	100
2015	325	700257743H1	SATMON017	g1184771	BLASTN	352	1e-43	92
2016	325	700072283H1	SATMON007	g1184773	BLASTN	626	1e-43	99
2017	325	700260796H1	SATMON017	g22237	BLASTN	628	1e-43	99
2018	325	700262496H1	SATMON017	g1184771	BLASTN	455	1e-42	90
2019	325	700155358H1	SATMON007	g1184771	BLASTN	610	1e-42	100
2020	325	700196762H1	SATMON014	g1184773	BLASTN	615	1e-42	100
2021	325	700450601H1	SATMON028	g22237	BLASTN	615	1e-42	96
2022	325	700581050H1	SATMON031	g22237	BLASTN	618	1e-42	99
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2026	325	700169472H1	SATMON013	g1184773	BLASTN	339	1e-37	93
2027	325	700377362H1	SATMON019	g1184773	BLASTN	550	1e-37	97
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2029	325	700440218H1	SATMON026	g22237	BLASTN	538	1e-36	91
2030	325	700440230H1	SATMON026	g22237	BLASTN	364	1e-35	97

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2035	325	700615893H1	SATMON033	g1184773	BLASTN	372	1e-33	92
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2047	325	700802094H1	SATMON036	g1184773	BLASTN	382	1e-23	79
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2058	3520	700101968H1	SATMON009	g168520	BLASTN	1002	1e-117	98
2059	3520	700099736H1	SATMON009	g168520	BLASTN	1030	1e-116	97
2060	3520	700096850H1	SATMON008	g168520	BLASTN	938	1e-115	97
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2062	3520	700092378H1	SATMON008	g168520	BLASTN	651	1e-114	98
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2068	3520	700097454H1	SATMON009	g168520	BLASTN	1028	1e-111	98
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2072	3520	700098981H1	SATMON009	g168520	BLASTN	1023	1e-109	98
2073	3520	700053377H1	SATMON009	g168478	BLASTN	1420	1e-109	100
2074	3520	700101538H1	SATMON009	g168520	BLASTN	958	1e-108	98
2075	3520	700093413H1	SATMON008	g168520	BLASTN	1037	1e-108	99
2076	3520	700098960H1	SATMON009	g168478	BLASTN	1004	1e-106	96
2077	3520	700212674H1	SATMON016	g168520	BLASTN	977	1e-105	98
2078	3520	700098986H1	SATMON009	g168478	BLASTN	1033	1e-105	98
2079	3520	700099244H1	SATMON009	g168520	BLASTN	976	1e-104	98
2080	3520	700100392H1	SATMON009	g168520	BLASTN	1002	1e-104	96
2081	3520	700044021H1	SATMON004	g168478	BLASTN	1350	1e-103	98
2082	3520	700043432H1	SATMON004	g168520	BLASTN	950	1e-102	97
2083	3520	700045175H1	SATMON004	g168520	BLASTN	963	1e-102	99
2084	3520	700099592H1	SATMON009	g168520	BLASTN	972	1e-102	94

2085	3520	700101559H1	SATMON009	g168478	BLASTN	1236	1e-102	94
2086	3520	700045717H1	SATMON004	g168478	BLASTN	1337	1e-102	96
2087	3520	700100711H1	SATMON009	g168520	BLASTN	996	1e-101	96
2088	3520	700098021H1	SATMON009	g168478	BLASTN	1189	1e-101	99
2089	3520	700044254H1	SATMON004	g22239	BLASTN	1327	1e-101	98
2090	3520	700041717H1	SATMON004	g168520	BLASTN	1010	1e-100	97
2091	3520	700044347H1	SATMON004	g168520	BLASTN	1028	1e-99	98
2092	3520	700097318H1	SATMON009	g168478	BLASTN	1121	1e-99	97
2093	3520	700045244H1	SATMON004	g22239	BLASTN	1295	1e-99	98
2094	3520	700041539H1	SATMON004	g168478	BLASTN	1300	1e-99	100
2095	3520	700100339H1	SATMON009	g168520	BLASTN	1014	1e-98	97
2096	3520	700099768H1	SATMON009	g168520	BLASTN	519	1e-97	96
2097	3520	700043795H1	SATMON004	g168520	BLASTN	973	1e-97	97
2098	3520	700043117H1	SATMON004	g168520	BLASTN	1007	1e-97	97
2099	3520	700211227H1	SATMON016	g168520	BLASTN	694	1e-96	92
2100	3520	700044187H1	SATMON004	g168520	BLASTN	958	1e-96	98
2101	3520	700025676H1	SATMON004	g168478	BLASTN	1259	1e-95	98
2102	3520	700094879H1	SATMON008	g168478	BLASTN	843	1e-94	95
2103	3520	700217617H1	SATMON016	g168520	BLASTN	898	1e-94	93
2104	3520	700404848H1	SATMON026	g168520	BLASTN	1039	1e-94	88
2105	3520	700044959H1	SATMON004	g168520	BLASTN	1000	1e-93	95
2106	3520	700213689H1	SATMON016	g168520	BLASTN	1007	1e-93	97
2107	3520	700210347H1	SATMON016	g168520	BLASTN	1191	1e-92	90
2108	3520	700045145H1	SATMON004	g168520	BLASTN	988	1e-91	98
2109	3520	700217745H1	SATMON016	g168520	BLASTN	1037	1e-91	98
2110	3520	700099288H1	SATMON009	g168478	BLASTN	1120	1e-91	93
2111	3520	700099630H1	SATMON009	g168520	BLASTN	445	1e-88	92
2112	3520	700214977H1	SATMON016	g22239	BLASTN	1084	1e-88	96
2113	3520	700045545H1	SATMON004	g22239	BLASTN	1161	1e-88	95
2114	3520	700198007H1	SATMON016	g22239	BLASTN	1167	1e-88	99
2115	3520	700216050H1	SATMON016	g168520	BLASTN	681	1e-85	88
2116	3520	700214595H1	SATMON016	g168478	BLASTN	975	1e-84	98
2117	3520	700215383H1	SATMON016	g168478	BLASTN	1021	1e-84	98
2118	3520	700098015H1	SATMON009	g168478	BLASTN	1080	1e-81	79
2119	3520	700210596H1	SATMON016	g168520	BLASTN	575	1e-79	92
2120	3520	700440284H1	SATMON026	g168478	BLASTN	914	1e-76	93
2121	3520	700215096H1	SATMON016	g168478	BLASTN	866	1e-75	95
2122	3520	700207885H1	SATMON016	g168520	BLASTN	408	1e-70	97
2123	3520	700044936H1	SATMON004	g168520	BLASTN	414	1e-68	89
2124	3520	700042261H1	SATMON004	g22239	BLASTN	579	1e-67	97
2125	3520	700213316H1	SATMON016	g22239	BLASTN	742	1e-53	98
2126	3520	700101372H1	SATMON009	g22239	BLASTN	625	1e-43	100
2127	3520	700053328H1	SATMON009	g168478	BLASTN	628	1e-43	99
2128	3520	700100601H1	SATMON009	g168478	BLASTN	610</		

2139	4750	700073493H1	SATMON007	g1100222	BLASTN	513	1e-32	68
2140	482	700281924H2	SATMON021	g1100224	BLASTN	835	1e-60	79
2141	482	700076167H1	SATMON007	g1100224	BLASTN	765	1e-54	78
2142	482	700106880H1	SATMON010	g1100222	BLASTN	713	1e-50	79
2143	482	700343834H1	SATMON021	g1100224	BLASTN	650	1e-45	79
2144	482	700612539H1	SATMON033	g1100224	BLASTN	584	1e-39	80
2145	482	700017623H1	SATMON001	g1100224	BLASTN	535	1e-35	81
2146	5054	700043423H1	SATMON004	g1185553	BLASTN	241	1e-9	90
2147	5609	700098586H1	SATMON009	g2331136	BLASTN	1069	1e-80	80
2148	5609	700101965H1	SATMON009	g2331136	BLASTN	973	1e-72	78
2149	5609	700097652H1	SATMON009	g22239	BLASTN	530	1e-70	77
2150	5609	700045073H1	SATMON004	g2331136	BLASTN	908	1e-67	83
2151	5609	700100461H1	SATMON009	g2331136	BLASTN	896	1e-66	84
2152	5609	700100784H1	SATMON009	g22239	BLASTN	306	1e-65	79
2153	5609	700041674H1	SATMON004	g22239	BLASTN	893	1e-65	81
2154	5609	700101071H1	SATMON009	g22239	BLASTN	867	1e-63	79
2155	5609	700099485H1	SATMON009	g168478	BLASTN	462	1e-61	83
2156	5609	700101345H1	SATMON009	g2331136	BLASTN	744	1e-61	78
2157	5609	700043784H1	SATMON004	g22239	BLASTN	842	1e-61	80
2158	5609	700099589H1	SATMON009	g2331136	BLASTN	707	1e-60	76
2159	5609	700099264H1	SATMON009	g168478	BLASTN	568	1e-58	78
2160	5609	700041766H1	SATMON004	g168478	BLASTN	615	1e-58	86
2161	5609	700098403H1	SATMON009	g168521	BLASTN	798	1e-58	80
2162	5609	700042111H1	SATMON004	g21251	BLASTN	791	1e-57	75
2163	5609	700042979H1	SATMON004	g21251	BLASTN	783	1e-56	75
2164	5609	700579708H1	SATMON031	g21251	BLASTN	770	1e-55	76
2165	5609	700097230H1	SATMON009	g1181547	BLASTN	677	1e-47	75
2166	5609	700097983H1	SATMON009	g1181547	BLASTN	644	1e-44	76
2167	5609	700099990H1	SATMON009	g22239	BLASTN	633	1e-43	78
2168	5609	700404886H1	SATMON026	g22239	BLASTN	621	1e-42	79
2169	5609	700101261H1	SATMON009	g22239	BLASTN	306	1e-41	78
2170	5609	700025513H1	SATMON004	g21251	BLASTN	592	1e-40	72
2171	5609	700042534H1	SATMON004	g1181547	BLASTN	575	1e-39	73
2172	5609	700404890H1	SATMON026	g168520	BLASTN	324	1e-27	81
2173	5609	700100028H1	SATMON009	g1181547	BLASTN	435	1e-25	77
2174	5609	700097683H1	SATMON009	g170239	BLASTX	211	1e-22	92
2175	5609	700045480H1	SATMON004	g170239	BLASTX	202	1e-20	92
2176	5609	700101596H1	SATMON009	g21252	BLASTX	129	1e-17	80
2177	5609	700434377H1	SATMONN01	g168524	BLASTX	70	1e-16	94
2178	5609	700043206H1	SATMON004	g170239	BLASTX	150	1e-16	87
2179	5609	700025514H1	SATMON004	g21251	BLASTN	276	1e-14	69
2180	5609	700198075H1	SATMON016	g170239	BLASTX	138	1e-13	79
2181	5609	700100768H1	SATMON009	g21252	BLASTX	50	1e-10	78
2182	5609	700043373H1	SATMON004	g2125				



2190	-L1435747	LIB143-049-Q1-E1-H4	LIB143	g1184775	BLASTN	161	1e-13	85
2191	-L1482841	LIB148-009-Q1-E1-G2	LIB148	g717080	BLASTN	683	1e-46	75
2192	-L1891511	LIB189-007-Q1-E1-B4	LIB189	g168478	BLASTN	186	1e-12	85
2193	-L1893431	LIB189-023-Q1-E1-B8	LIB189	g168520	BLASTN	780	1e-58	80
2194	-L30591771	LIB3059-004-Q1-K1-C3	LIB3059	g1184773	BLASTN	253	1e-10	79
2195	-L30592823	LIB3059-013-Q1-K1-B4	LIB3059	g1184775	BLASTN	876	1e-64	94
2196	-L30595676	LIB3059-059-Q1-K1-D6	LIB3059	g1912310	BLASTX	138	1e-27	82
2197	-L30596448	LIB3059-052-Q1-K1-E5	LIB3059	g22302	BLASTN	207	1e-13	70
2198	-L30596730	LIB3059-055-Q1-K1-C8	LIB3059	g717080	BLASTN	234	1e-10	78
2199	-L30601281	LIB3060-001-Q1-K1-A9	LIB3060	g168520	BLASTN	762	1e-77	84
2200	-L30601466	LIB3060-002-Q1-K2-G3	LIB3060	g22239	BLASTN	153	1e-9	76
2201	-L30602361	LIB3060-004-Q1-K1-E12	LIB3060	g168521	BLASTN	935	1e-71	93
2202	-L30603772	LIB3060-040-Q1-K1-H9	LIB3060	g168520	BLASTN	766	1e-78	87
2203	-L30604121	LIB3060-037-Q1-K1-B8	LIB3060	g168478	BLASTN	238	1e-9	70
2204	-L30604680	LIB3060-024-Q1-K1-C10	LIB3060	g168520	BLASTN	490	1e-57	81
2205	-L30604772	LIB3060-020-Q1-K1-B1	LIB3060	g22237	BLASTN	344	1e-19	75
2206	-L30605068	LIB3060-023-Q1-K1-D10	LIB3060	g21252	BLASTX	77	1e-25	55
2207	-L30614406	LIB3061-034-Q1-K1-H4	LIB3061	g1184773	BLASTN	138	1e-20	95
2208	-L30621659	LIB3062-004-Q1-K1-D3	LIB3062	g1185553	BLASTN	263	1e-10	73
2209	-L30624091	LIB3062-022-Q1-K1-G4	LIB3062	g1184771	BLASTN	457	1e-29	61
2210	-L30625111	LIB3062-047-Q1-K1-F4	LIB3062	g168478	BLASTN	268	1e-13	77
2211	-L30625390	LIB3062-045-Q1-K1-B5	LIB3062	g3059121	BLASTN	246	1e-9	71
2212	-L30625502	LIB3062-045-Q1-K1-H6	LIB3062	g1184771	BLASTN	749	1e-93	78
2213	-L30626082	LIB3062-057-Q1-K1-A6	LIB3062	g22237	BLASTN	344	1e-19	80
2214	-L30661786	LIB3066-011-Q1-K1-G4	LIB3066	g1185553	BLASTN	410	1e-25	84
2215	-L30662411	LIB3066-035-Q1-K1-C8	LIB3066	g1184773	BLASTN	270	1e-13	93
2216	-L30664919	LIB3066-021-Q1-K1-B3	LIB3066	g1185553	BLASTN	346	1e-30	87

2217	-L30672802	LIB3067-016-Q1-K1-F10	LIB3067	g1184771	BLASTN	681	1e-53	70
2218	-L30673570	LIB3067-005-Q1-K1-A12	LIB3067	g1185553	BLASTN	466	1e-29	92
2219	-L30675145	LIB3067-055-Q1-K1-H11	LIB3067	g22237	BLASTN	438	1e-27	79
2220	-L30681335	LIB3068-001-Q1-K1-F4	LIB3068	g169851	BLASTN	540	1e-34	68
2221	-L30683415	LIB3068-036-Q1-K1-F4	LIB3068	g1628381	BLASTX	78	1e-30	55
2222	-L30692589	LIB3069-019-Q1-K1-H1	LIB3069	g22238	BLASTX	132	1e-26	40
2223	-L30693586	LIB3069-025-Q1-K1-F9	LIB3069	g1185553	BLASTN	327	1e-15	86
2224	-L30784053	LIB3078-029-Q1-K1-F12	LIB3078	g168479	BLASTX	130	1e-32	47
2225	-L30784418	LIB3078-039-Q1-K1-A2	LIB3078	g2331136	BLASTN	566	1e-38	74
2226	-L30791369	LIB3079-001-Q1-K1-G1	LIB3079	g1184771	BLASTN	1199	1e-96	84
2227	-L361450	LIB36-002-Q1-E1-C8	LIB36	g168478	BLASTN	698	1e-48	77
2228	-L362980	LIB36-019-Q1-E1-H2	LIB36	g22239	BLASTN	409	1e-25	83
2229	-L363043	LIB36-015-Q1-E1-G8	LIB36	g1184771	BLASTN	312	1e-58	83
2230	-L831348	LIB83-003-Q1-E1-A11	LIB83	g168478	BLASTN	286	1e-12	98
2231	-L832266	LIB83-007-Q1-E1-C2	LIB83	g1185555	BLASTN	381	1e-22	68
2232	-L841577	LIB84-027-Q1-E1-H4	LIB84	g168478	BLASTN	457	1e-29	95
2233	-L841855	LIB84-030-Q1-E1-C10	LIB84	g1185555	BLASTN	231	1e-10	75
2234	-L84758	LIB84-016-Q1-E1-E5	LIB84	g474407	BLASTN	1346	1e-133	97
2235	12126	LIB3062-056-Q1-K1-C9	LIB3062	g169851	BLASTN	890	1e-65	71
2236	1334	LIB143-061-Q1-E1-G2	LIB143	g717080	BLASTN	310	1e-14	83
2237	1334	LIB84-012-Q1-E12-B5	LIB84	g717080	BLASTN	289	1e-12	79
2238	13427	LIB3067-056-Q1-K1-B4	LIB3067	g1185553	BLASTN	489	1e-30	88
2239	13947	LIB3061-037-Q1-K1-C8	LIB3061	g1185553	BLASTN	334	1e-16	83
2240	17968	LIB3059-042-Q1-K1-G12	LIB3059	g1184775	BLASTN	1641	1e-128	98
2241	2468	LIB84-002-Q1-E1-A7	LIB84	g168478	BLASTN	1251	1e-95	99
2242	2468	LIB83-001-Q1-E1-E4	LIB83	g22239	BLASTN	860	1e-62	100
2243	26686	LIB3069-013-Q1-K1-H10	LIB3069	g1184772	BLASTX	155	1e-29	42

2244	27323	LIB3078-024-Q1-K1-G1	LIB3078	g474407	BLASTN	1386	1e-106	99
2245	27323	LIB3069-038-Q1-K1-F4	LIB3069	g474407	BLASTN	1025	1e-93	99
2246	27785	LIB148-039-Q1-E1-A11	LIB148	g1185553	BLASTN	495	1e-30	83
2247	27785	LIB148-006-Q1-E1-B8	LIB148	g1185553	BLASTN	267	1e-10	79
2248	29041	LIB148-017-Q1-E1-D6	LIB148	g1185553	BLASTN	410	1e-27	86
2249	29041	LIB148-024-Q1-E1-C10	LIB148	g1185553	BLASTN	441	1e-27	86
2250	29041	LIB148-058-Q1-E1-D8	LIB148	g1185553	BLASTN	441	1e-27	86
2251	29041	LIB143-040-Q1-E1-H8	LIB143	g1185553	BLASTN	441	1e-26	86
2252	30017	LIB148-057-Q1-E1-H7	LIB148	g717080	BLASTN	264	1e-10	65
2253	30327	LIB36-012-Q1-E1-B4	LIB36	g22302	BLASTN	266	1e-30	83
2254	31280	LIB36-002-Q1-E1-A4	LIB36	g1185553	BLASTN	337	1e-16	79
2255	32165	LIB36-013-Q1-E1-F8	LIB36	g474407	BLASTN	1417	1e-109	91
2256	325	LIB3062-009-Q1-K1-B6	LIB3062	g22237	BLASTN	2130	1e-169	100
2257	325	LIB3059-029-Q1-K1-E5	LIB3059	g1184771	BLASTN	2098	1e-166	98
2258	325	LIB3066-001-Q1-K1-C3	LIB3066	g1184773	BLASTN	2063	1e-163	95
2259	325	LIB3067-029-Q1-K1-F10	LIB3067	g1184775	BLASTN	1334	1e-162	96
2260	325	LIB3062-012-Q1-K1-C5	LIB3062	g22237	BLASTN	1952	1e-162	99
2261	325	LIB3061-011-Q1-K1-H1	LIB3061	g1184773	BLASTN	1973	1e-160	99
2262	325	LIB3061-034-Q1-K1-H6	LIB3061	g1184773	BLASTN	2027	1e-160	98
2263	325	LIB3061-011-Q1-K1-D5	LIB3061	g22237	BLASTN	1691	1e-159	98
2264	325	LIB3068-026-Q1-K1-E3	LIB3068	g22237	BLASTN	1899	1e-159	98
2265	325	LIB3061-034-Q1-K1-A7	LIB3061	g1184773	BLASTN	1890	1e-158	98
2266	325	LIB143-006-Q1-E1-F5	LIB143	g1184773	BLASTN	1454	1e-157	95
2267	325	LIB3068-008-Q1-K1-H2	LIB3068	g1184771	BLASTN	1673	1e-157	94
2268	325	LIB3060-001-Q1-K2-C11	LIB3060	g1184771	BLASTN	1673	1e-155	96
2269	325	LIB3059-042-Q1-K1-G11	LIB3059	g1184773	BLASTN	1751	1e-154	97
2270	325	LIB3060-053-Q1-K1-H6	LIB3060	g1184771	BLASTN	1954	1e-154	99

2271	325	LIB3062-001-Q1-K2-B9	LIB3062	g22237	BLASTN	1836	1e-152	93
2272	325	LIB143-050-Q1-E1-C2	LIB143	g1184773	BLASTN	1837	1e-152	94
2273	325	LIB3059-002-Q1-K2-D10	LIB3059	g1184773	BLASTN	1933	1e-152	94
2274	325	LIB3066-021-Q1-K1-G1	LIB3066	g1184773	BLASTN	1482	1e-151	92
2275	325	LIB36-006-Q1-E1-G10	LIB36	g1184771	BLASTN	1915	1e-151	96
2276	325	LIB3061-013-Q1-K1-D10	LIB3061	g1184773	BLASTN	1918	1e-151	96
2277	325	LIB3062-035-Q1-K1-B9	LIB3062	g22237	BLASTN	849	1e-150	94
2278	325	LIB3068-002-Q1-K1-D3	LIB3068	g1184771	BLASTN	1056	1e-150	97
2279	325	LIB3059-030-Q1-K1-E12	LIB3059	g1184773	BLASTN	1912	1e-150	99
2280	325	LIB3059-048-Q1-K1-D4	LIB3059	g1184773	BLASTN	1649	1e-148	90
2281	325	LIB143-025-Q1-E1-E8	LIB143	g22237	BLASTN	1887	1e-148	94
2282	325	LIB143-057-Q1-E1-E6	LIB143	g1184773	BLASTN	1496	1e-146	95
2283	325	LIB143-015-Q1-E1-F12	LIB143	g1184771	BLASTN	1855	1e-146	100
2284	325	LIB3060-049-Q1-K1-H7	LIB3060	g1184771	BLASTN	1858	1e-146	99
2285	325	LIB143-025-Q1-E1-H7	LIB143	g1184771	BLASTN	1413	1e-142	95
2286	325	LIB84-027-Q1-E1-F5	LIB84	g22237	BLASTN	1654	1e-142	97
2287	325	LIB36-003-Q1-E1-C2	LIB36	g1184771	BLASTN	1536	1e-141	96
2288	325	LIB3067-032-Q1-K1-B12	LIB3067	g1184773	BLASTN	1121	1e-139	94
2289	325	LIB3069-038-Q1-K1-F9	LIB3069	g22237	BLASTN	1372	1e-137	90
2290	325	LIB3066-021-Q1-K1-G2	LIB3066	g1184773	BLASTN	1535	1e-136	94
2291	325	LIB3069-043-Q1-K1-A1	LIB3069	g22237	BLASTN	1483	1e-134	93
2292	325	LIB3060-020-Q1-K1-A12	LIB3060	g1184771	BLASTN	1110	1e-132	95
2293	325	LIB143-014-Q1-E1-F8	LIB143	g1184773	BLASTN	1625	1e-130	93
2294	325	LIB3066-021-Q1-K1-G3	LIB3066	g1184773	BLASTN	1221	1e-127	86
2295	325	LIB3066-004-Q1-K1-G9	LIB3066	g1184771	BLASTN	1482	1e-125	91
2296	325	LIB143-055-Q1-E1-B3	LIB143	g1184771	BLASTN	1503	1e-125	87
2297	325	LIB3060-046-Q1-K1-C4	LIB3060	g1184771	BLASTN	1315	1e-124	95

2298	325	LIB3060-012-Q1-K1-E9	LIB3060	g22237	BLASTN	1432	1e-123	94
2299	325	LIB3066-037-Q1-K1-A2	LIB3066	g1184771	BLASTN	837	1e-121	90
2300	325	LIB3067-031-Q1-K1-G12	LIB3067	g1184773	BLASTN	923	1e-121	90
2301	325	LIB143-049-Q1-E1-D6	LIB143	g1184771	BLASTN	1497	1e-119	99
2302	325	LIB3060-022-Q1-K1-E7	LIB3060	g22237	BLASTN	1168	1e-117	89
2303	325	LIB143-012-Q1-E1-C2	LIB143	g1184773	BLASTN	1501	1e-116	95
2304	325	LIB36-006-Q1-E1-D9	LIB36	g22237	BLASTN	1464	1e-113	95
2305	325	LIB3060-001-Q1-K2-C12	LIB3060	g1184771	BLASTN	981	1e-112	88
2306	325	LIB143-063-Q1-E1-G8	LIB143	g1184773	BLASTN	1354	1e-110	87
2307	325	LIB3060-028-Q1-K1-E1	LIB3060	g22237	BLASTN	613	1e-109	93
2308	325	LIB3061-001-Q1-K2-H1	LIB3061	g1184771	BLASTN	743	1e-107	86
2309	325	LIB143-017-Q1-E1-G4	LIB143	g1184773	BLASTN	1217	1e-107	92
2310	325	30-LIB84-007-Q1-E1-H5	LIB84	g1184771	BLASTN	988	1e-106	95
2311	325	LIB3061-056-Q1-K1-F11	LIB3061	g1184773	BLASTN	1382	1e-106	89
2312	325	LIB3062-023-Q1-K1-F7	LIB3062	g22237	BLASTN	1373	1e-105	79
2313	325	LIB3068-055-Q1-K1-G2	LIB3068	g1184771	BLASTN	566	1e-101	90
2314	325	LIB143-050-Q1-E1-C3	LIB143	g1184773	BLASTN	980	1e-100	87
2315	325	LIB3061-005-Q1-K1-B3	LIB3061	g1184773	BLASTN	816	1e-99	92
2316	325	LIB3068-051-Q1-K1-C5	LIB3068	g1184771	BLASTN	658	1e-95	96
2317	325	LIB3068-021-Q1-K1-C5	LIB3068	g22237	BLASTN	1074	1e-92	94
2318	325	LIB3059-002-Q1-K2-D11	LIB3059	g1184773	BLASTN	905	1e-91	86
2319	325	LIB143-029-Q1-E1-E1	LIB143	g22237	BLASTN	979	1e-91	96
2320	325	LIB3062-016-Q1-K1-E1	LIB3062	g1184775	BLASTN	1164	1e-91	98
2321	325	LIB3062-035-Q1-K1-H4	LIB3062	g1184771	BLASTN	1058	1e-89	90
2322	325	LIB189-023-Q1-E1-F1	LIB189	g22237	BLASTN	589	1e-88	87
2323	325	LIB143-067-Q1-E1-H11	LIB143	g1184771	BLASTN	777	1e-84	88
2324	325	LIB3061-024-Q1-K1-C11	LIB3061	g1184773	BLASTN	838	1e-78	94

2325	325	LIB3068-041-Q1-K1-B11	LIB3068	g1184771	BLASTN	680	1e-77	95
2326	325	LIB3068-026-Q1-K1-D5	LIB3068	g1184771	BLASTN	680	1e-69	94
2327	325	LIB3061-012-Q1-K1-C11	LIB3061	g1184773	BLASTN	744	1e-66	87
2328	325	LIB143-066-Q1-E1-H11	LIB143	g1184771	BLASTN	634	1e-64	93
2329	325	LIB3059-004-Q1-K1-G1	LIB3059	g1184771	BLASTN	818	1e-59	93
2330	325	LIB3069-053-Q1-K1-D10	LIB3069	g1184771	BLASTN	347	1e-46	89
2331	325	LIB143-021-Q1-E1-E2	LIB143	g1184773	BLASTN	367	1e-35	90
2332	325	LIB3062-057-Q1-K1-A8	LIB3062	g22237	BLASTN	536	1e-35	99
2333	325	LIB189-019-Q1-E1-C5	LIB189	g1184773	BLASTN	485	1e-31	91
2334	325	LIB143-037-Q1-E1-C8	LIB143	g22237	BLASTN	486	1e-31	98
2335	325	LIB3059-012-Q1-K1-F6	LIB3059	g1184773	BLASTN	253	1e-12	98
2336	3520	LIB3078-050-Q1-K1-G8	LIB3078	g168478	BLASTN	2101	1e-166	94
2337	3520	LIB3060-041-Q1-K1-E8	LIB3060	g22239	BLASTN	2038	1e-161	95
2338	3520	LIB3078-055-Q1-K1-H5	LIB3078	g168478	BLASTN	1903	1e-149	92
2339	3520	LIB3060-001-Q1-K2-A9	LIB3060	g168520	BLASTN	1862	1e-148	98
2340	3520	LIB3060-043-Q1-K1-C11	LIB3060	g168520	BLASTN	1848	1e-147	97
2341	3520	LIB3060-003-Q1-K1-D9	LIB3060	g168520	BLASTN	1853	1e-147	97
2342	3520	LIB3060-041-Q1-K1-F6	LIB3060	g168520	BLASTN	1830	1e-145	97
2343	3520	LIB3060-043-Q1-K1-F2	LIB3060	g168520	BLASTN	1327	1e-144	96
2344	3520	LIB3060-047-Q1-K1-C9	LIB3060	g168520	BLASTN	1797	1e-143	97
2345	3520	LIB84-017-Q1-E1-D3	LIB84	g168520	BLASTN	1536	1e-142	97
2346	3520	LIB36-002-Q1-E1-B8	LIB36	g168520	BLASTN	1573	1e-142	97
2347	3520	LIB3060-029-Q1-K1-B7	LIB3060	g168520	BLASTN	1675	1e-140	97
2348	3520	LIB36-010-Q1-E1-C7	LIB36	g168520	BLASTN	1550	1e-139	96
2349	3520	LIB3060-042-Q1-K1-A10	LIB3060	g168520	BLASTN	1601	1e-139	97
2350	3520	LIB3060-018-Q1-K1-F11	LIB3060	g22239	BLASTN	1773	1e-139	95
2351	3520	LIB36-003-Q1-E1-H7	LIB36	g22239	BLASTN	1523	1e-137	98

2352	3520	LIB189-029-Q1-E1-F9	LIB189	g168520	BLASTN	1531	1e-136	96
2353	3520	LIB36-006-Q1-E1-B1	LIB36	g168478	BLASTN	1118	1e-130	96
2354	3520	LIB3060-021-Q1-K1-F4	LIB3060	g168520	BLASTN	1627	1e-129	96
2355	3520	LIB3060-037-Q1-K1-B6	LIB3060	g168520	BLASTN	1625	1e-128	95
2356	3520	LIB84-003-Q1-E1-C1	LIB84	g168520	BLASTN	726	1e-121	92
2357	3520	LIB36-021-Q1-E1-H3	LIB36	g168520	BLASTN	1537	1e-121	97
2358	3520	LIB3078-056-Q1-K1-G1	LIB3078	g22239	BLASTN	1539	1e-119	96
2359	3520	LIB3060-025-Q1-K1-B12	LIB3060	g168520	BLASTN	1416	1e-118	96
2360	3520	LIB189-004-Q1-E1-F9	LIB189	g168520	BLASTN	1499	1e-118	88
2361	3520	LIB3060-035-Q1-K1-A11	LIB3060	g168520	BLASTN	1339	1e-117	96
2362	3520	LIB3078-004-Q1-K1-D8	LIB3078	g22239	BLASTN	1256	1e-116	91
2363	3520	LIB36-009-Q1-E1-H1	LIB36	g168478	BLASTN	1318	1e-115	98
2364	3520	LIB3060-013-Q1-K1-F8	LIB3060	g168478	BLASTN	1205	1e-112	92
2365	3520	LIB3060-041-Q1-K1-G11	LIB3060	g168520	BLASTN	1332	1e-104	84
2366	3520	LIB3060-018-Q1-K1-F10	LIB3060	g22239	BLASTN	718	1e-100	90
2367	3520	LIB3060-008-Q1-K1-F1	LIB3060	g168520	BLASTN	532	1e-36	83
2368	3520	LIB3060-039-Q1-K1-E4	LIB3060	g168520	BLASTN	441	1e-35	88
2369	5609	LIB3060-016-Q1-K1-F3	LIB3060	g22239	BLASTN	787	1e-99	78
2370	5609	LIB36-020-Q1-E1-A6	LIB36	g168478	BLASTN	756	1e-91	81
2371	5609	LIB189-011-Q1-E1-H7	LIB189	g2331136	BLASTN	945	1e-90	77
2372	5609	LIB36-019-Q1-E1-B10	LIB36	g168478	BLASTN	950	1e-90	77
2373	5609	LIB3060-049-Q1-K1-A12	LIB3060	g336389	BLASTN	1076	1e-80	73
2374	5609	LIB36-021-Q1-E1-H8	LIB36	g168478	BLASTN	926	1e-76	79
2375	5609	LIB84-028-Q1-E1-H5	LIB84	g21251	BLASTN	866	1e-66	77
2376	5609	LIB3060-036-Q1-K1-B9	LIB3060	g21251	BLASTN	827	1e-60	70
2377	5609	LIB36-001-Q1-E1-A3	LIB36	g168478	BLASTN	680	1e-58	86
2378	5609	LIB189-017-Q1-E1-C6	LIB189	g21252	BLASTX	228	1e-52	68

2379	5609	LIB189-015-Q1-E1-C5	LIB189	g168478	BLASTN	430	1e-51	75
2380	5609	LIB3060-035-Q1-K1-F2	LIB3060	g21252	BLASTX	215	1e-49	72
2381	5609	LIB36-003-Q1-E1-D2	LIB36	g21252	BLASTX	222	1e-43	76
2382	5609	LIB3060-023-Q1-K1-D9	LIB3060	g21252	BLASTX	105	1e-41	68
2383	5609	LIB3060-018-Q1-K1-E11	LIB3060	g168520	BLASTN	254	1e-26	75

#### MAIZE PUTATIVE GLYCERALDEHYDE 3-PHOSPHATE DEHYDROGENASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
2384	5609	700043392H1	SATMON004	g168567	BLASTN	926	1e-70	98
2385	5609	700041871H1	SATMON004	g168567	BLASTN	738	1e-54	99
2386	5609	700426511H1	SATMONN01	g168567	BLASTN	625	1e-45	100
2387	5609	700044710H1	SATMON004	g168567	BLASTN	570	1e-40	100
2388	5609	700216320H1	SATMON016	g168567	BLASTN	571	1e-40	99
2389	5609	700216328H1	SATMON016	g168567	BLASTN	413	1e-26	98
2390	5609	LIB36-006-Q1-E1-A7	LIB36	g168567	BLASTN	931	1e-70	99
2391	5609	LIB189-010-Q1-E1-F11	LIB189	g168567	BLASTN	915	1e-69	98
2392	5609	LIB83-006-Q1-E1-H8	LIB83	g168567	BLASTN	917	1e-69	98
2393	5609	LIB36-017-Q1-E1-A1	LIB36	g168567	BLASTN	486	1e-68	96
2394	5609	LIB3078-014-Q1-K1-H3	LIB3078	g168567	BLASTN	906	1e-68	97
2395	5609	LIB189-022-Q1-E1-H11	LIB189	g168567	BLASTN	931	1e-70	99
2396	5609	LIB3078-002-Q1-K1-B8	LIB3078	g168567	BLASTN	880	1e-66	97

#### SOYBEAN GLYCERALDEHYDE 3-PHOSPHATE DEHYDROGENASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
2397	-700556687	700556687H1	SOYMON001	g2905771	BLASTN	315	1e-27	91
2398	-700652993	700652993H1	SOYMON003	g20732	BLASTN	538	1e-34	84
2399	-700669859	700669859H1	SOYMON006	g19565	BLASTN	404	1e-24	78
2400	-700682023	700682023H1	SOYMON008	g1184775	BLASTN	659	1e-89	95
2401	-700739645	700739645H1	SOYMON012	g20732	BLASTN	906	1e-70	91
2402	-700744137	700744137H1	SOYMON013	g12158	BLASTN	344	1e-32	77
2403	-700749096	700749096H1	SOYMON013	g425795	BLASTN	337	1e-17	75
2404	-700763386	700763386H1	SOYMON015	g20550	BLASTN	560	1e-37	80
2405	-700854894	700854894H1	SOYMON023	g1184771	BLASTN	300	1e-19	79
2406	-700870634	700870634H1	SOYMON018	g20728	BLASTN	374	1e-21	68
2407	-700871731	700871731H1	SOYMON018	g309671	BLASTX	76	1e-8	49
2408	-700891638	700891638H1	SOYMON024	g496493	BLASTN	771	1e-55	82
2409	-700954983	700954983H1	SOYMON022	g1185556	BLASTX	131	1e-17	86
2410	-700961364	700961364H1	SOYMON022	g20732	BLASTN	267	1e-11	88
2411	-700961396	700961396H1	SOYMON022	g20732	BLASTN	330	1e-17	87
2412	-700963442	700963442H1	SOYMON022	g169090	BLASTN	485	1e-31	77



2413	-700984474	700984474H1	SOYMON009	g167293	BLASTN	432	1e-51	81
2414	-700989533	700989533H1	SOYMON011	g496493	BLASTN	1057	1e-79	90
2415	-700990284	700990284H1	SOYMON011	g2331137	BLASTX	177	1e-17	88
2416	-700991120	700991120H1	SOYMON011	g2905771	BLASTN	262	1e-11	96
2417	-700991826	700991826H1	SOYMON011	g20732	BLASTN	344	1e-29	71
2418	-700993359	700993359H1	SOYMON011	g19565	BLASTN	620	1e-42	76
2419	-701000288	701000288H1	SOYMON018	g20728	BLASTN	550	1e-43	77
2420	-701049142	701049142H1	SOYMON032	g3059121	BLASTN	612	1e-42	67
2421	-701049262	701049262H1	SOYMON032	g1100222	BLASTN	781	1e-56	77
2422	-701064532	701064532H1	SOYMON034	g19565	BLASTN	345	1e-19	87
2423	-701107753	701107753H1	SOYMON036	g496493	BLASTN	773	1e-55	77
2424	-701128594	701128594H1	SOYMON037	g19565	BLASTN	489	1e-31	83
2425	-701140262	701140262H1	SOYMON038	g169090	BLASTN	449	1e-28	85
2426	-701146678	701146678H1	SOYMON031	g2078298	BLASTX	52	1e-10	66
2427	-701151833	701151833H1	SOYMON031	g1931618	BLASTN	567	1e-38	81
2428	-701203691	701203691H2	SOYMON035	g169090	BLASTN	264	1e-11	87
2429	-701208478	701208478H1	SOYMON035	g169090	BLASTN	262	1e-22	69
2430	1061	700763870H1	SOYMON018	g20728	BLASTN	1054	1e-91	88
2431	1061	700556966H1	SOYMON001	g20728	BLASTN	1199	1e-91	91
2432	1061	700980735H1	SOYMON009	g20728	BLASTN	1140	1e-86	89
2433	1061	700983864H1	SOYMON009	g20728	BLASTN	1147	1e-86	88
2434	1061	700786535H1	SOYMON011	g12158	BLASTN	1086	1e-81	86
2435	1061	700728027H1	SOYMON009	g20728	BLASTN	767	1e-79	89
2436	1061	700684426H1	SOYMON008	g20728	BLASTN	1045	1e-78	90
2437	1061	700559635H1	SOYMON001	g20728	BLASTN	799	1e-77	85
2438	1061	700555476H1	SOYMON001	g20728	BLASTN	891	1e-77	87
2439	1061	700876005H1	SOYMON018	g20728	BLASTN	595	1e-76	88
2440	1061	700646201H1	SOYMON012	g12158	BLASTN	784	1e-75	88
2441	1061	700873429H1	SOYMON018	g20728	BLASTN	853	1e-75	88
2442	1061	700685875H1	SOYMON008	g20728	BLASTN	894	1e-75	89
2443	1061	700554131H1	SOYMON001	g20728	BLASTN	925	1e-75	88
2444	1061	700686559H1	SOYMON008	g20728	BLASTN	1012	1e-75	86
2445	1061	700873329H1	SOYMON018	g20728	BLASTN	1013	1e-75	89
2446	1061	701061532H1	SOYMON033	g20728	BLASTN	1017	1e-75	88
2447	1061	700876258H1	SOYMON018	g20728	BLASTN	562	1e-73	91
2448	1061	700991748H1	SOYMON011	g20728	BLASTN	646	1e-73	85
2449	1061	700752804H1	SOYMON014	g20728	BLASTN	984	1e-73	86
2450	1061	700873301H1	SOYMON018	g20728	BLASTN	988	1e-73	87
2451	1061	700977867H1	SOYMON009	g20728	BLASTN	974	1e-72	86
2452	1061	700558508H1	SOYMON001	g12158	BLASTN	562	1e-71	85
2453	1061	700558346H1	SOYMON001	g12158	BLASTN	800	1e-71	89
2454	1061	701104595H1	SOYMON036	g20728	BLASTN	958	1e-71	85
2455	1061	701107372H1	SOYMON036	g20728	BLASTN	959	1e-71	83
2456	1061	700877182H1	SOYMON018	g20728	BLASTN	963	1e-71	85
2457	1061	700682345H2	SOYMON008	g20728	BLASTN	965	1e-71	87
2458	1061	700999844H1	SOYMON018	g20728	BLASTN	965	1e-71	85
2459	1061	700962204H1	SOYMON022	g12158	BLASTN	968	1e-71	85
2460	1061	700962351H1	SOYMON022	g20728	BLASTN	525	1e-69	86
2461	1061	700743037H1	SOYMON012	g20728	BLASTN	563	1e-69	85
2462	1061	700975367H1	SOYMON009	g20728	BLASTN	938	1e-69	84
2463	1061	700844411H1	SOYMON021	g20728	BLASTN	944	1e-69	92
2464	1061	700891407H1	SOYMON024	g12158	BLASTN	946	1e-69	87
2465	1061	700556475H1	SOYMON001	g20728	BLASTN	743	1e-68	85
2466	1061	700739632H1	SOYMON012	g20728	BLASTN	849	1e-68	83



2521	1061	700874946H1	SOYMON018	g20728	BLASTN	735	1e-52	86
2522	1061	700789664H2	SOYMON011	g20728	BLASTN	735	1e-52	86
2523	1061	700559731H1	SOYMON001	g20728	BLASTN	735	1e-52	86
2524	1061	701141680H1	SOYMON038	g20728	BLASTN	735	1e-52	86
2525	1061	700555668H1	SOYMON001	g20728	BLASTN	735	1e-52	86
2526	1061	700553965H1	SOYMON001	g20728	BLASTN	735	1e-52	86
2527	1061	700989276H1	SOYMON011	g20728	BLASTN	735	1e-52	86
2528	1061	701213488H1	SOYMON035	g20728	BLASTN	735	1e-52	86
2529	1061	701120382H1	SOYMON037	g20728	BLASTN	735	1e-52	86
2530	1061	700740875H1	SOYMON012	g20728	BLASTN	735	1e-52	86
2531	1061	700741835H1	SOYMON012	g20728	BLASTN	736	1e-52	85
2532	1061	700995653H1	SOYMON011	g20728	BLASTN	736	1e-52	85
2533	1061	700906218H1	SOYMON022	g20728	BLASTN	736	1e-52	85
2534	1061	700684347H1	SOYMON008	g20728	BLASTN	736	1e-52	85
2535	1061	700728605H1	SOYMON009	g20728	BLASTN	737	1e-52	86
2536	1061	700789578H2	SOYMON011	g20728	BLASTN	740	1e-52	87
2537	1061	700787421H2	SOYMON011	g20728	BLASTN	718	1e-51	84
2538	1061	700560934H1	SOYMON001	g20728	BLASTN	719	1e-51	84
2539	1061	700876650H1	SOYMON018	g20728	BLASTN	722	1e-51	84
2540	1061	700740868H1	SOYMON012	g20728	BLASTN	722	1e-51	84
2541	1061	700741374H1	SOYMON012	g20728	BLASTN	722	1e-51	84
2542	1061	700994074H1	SOYMON011	g20728	BLASTN	723	1e-51	86
2543	1061	701109502H1	SOYMON036	g20728	BLASTN	728	1e-51	86
2544	1061	700875104H1	SOYMON018	g20728	BLASTN	728	1e-51	86
2545	1061	700786270H2	SOYMON011	g20728	BLASTN	728	1e-51	86
2546	1061	700556484H1	SOYMON001	g20728	BLASTN	729	1e-51	84
2547	1061	700998979H1	SOYMON018	g20728	BLASTN	729	1e-51	84
2548	1061	701109358H1	SOYMON036	g20728	BLASTN	729	1e-51	84
2549	1061	700763760H1	SOYMON018	g12158	BLASTN	730	1e-51	83
2550	1061	701001681H1	SOYMON018	g20728	BLASTN	422	1e-50	85
2551	1061	700991945H1	SOYMON011	g20728	BLASTN	706	1e-50	83
2552	1061	700789781H1	SOYMON011	g20728	BLASTN	709	1e-50	87
2553	1061	700554372H1	SOYMON001	g20728	BLASTN	709	1e-50	83
2554	1061	700993753H1	SOYMON011	g12158	BLASTN	709	1e-50	87
2555	1061	700876992H1	SOYMON018	g20728	BLASTN	714	1e-50	85
2556	1061	700960223H1	SOYMON022	g20728	BLASTN	714	1e-50	85
2557	1061	700686495H1	SOYMON008	g20728	BLASTN	717	1e-50	85
2558	1061	700557711H1	SOYMON001	g20728	BLASTN	469	1e-49	83
2559	1061	700984028H1	SOYMON009	g20728	BLASTN	560	1e-49	82
2560	1061	700556584H1	SOYMON001	g20728	BLASTN	563	1e-49	86
2561	1061	700870942H1	SOYMON018	g20728	BLASTN	576	1e-49	78
2562	1061	700871710H1	SOYMON018	g166701	BLASTN	695	1e-49	79
2563	1061	700738589H1	SOYMON012	g20728	BLASTN	697	1e-49	86
2564	1061	700738856H1	SOYMON012	g20728	BLASTN	704	1e-49	86
2565	1061	701002335H1	SOYMON018	g20728	BLASTN	704	1e-49	85
2566	1061	701001628H1	SOYMON018	g20728	BLASTN	704	1e-49	85
2567	1061	700787485H2	SOYMON011	g20728	BLASTN	415	1e-48	83
2568	1061	700683818H1	SOYMON008	g12158	BLASTN	442	1e-48	82
2569	1061	700554247H1	SOYMON001	g20728	BLASTN	480	1e-48	84
2570	1061	700744021H1	SOYMON012	g20728	BLASTN	554	1e-48	84
2571	1061	700787533H1	SOYMON011	g20728	BLASTN	573	1e-48	84
2572	1061	700985942H1	SOYMON009	g20728	BLASTN	598	1e-48	85
2573	1061	701104728H1	SOYMON036	g20728	BLASTN	609	1e-48	83
2574	1061	700988933H1	SOYMON011	g20728	BLASTN	637	1e-48	85

2575	1061	701109795H1	SOYMON036	g20728	BLASTN	644	1e-48	87
2576	1061	700984329H1	SOYMON009	g20728	BLASTN	655	1e-48	86
2577	1061	701000601H1	SOYMON018	g20728	BLASTN	682	1e-48	86
2578	1061	700686572H1	SOYMON008	g20728	BLASTN	684	1e-48	86
2579	1061	700791971H1	SOYMON011	g20728	BLASTN	692	1e-48	86
2580	1061	700740621H1	SOYMON012	g20728	BLASTN	343	1e-47	84
2581	1061	700994492H1	SOYMON011	g20728	BLASTN	413	1e-47	86
2582	1061	701108677H1	SOYMON036	g20728	BLASTN	553	1e-47	85
2583	1061	700740371H1	SOYMON012	g12158	BLASTN	640	1e-47	84
2584	1061	700737944H1	SOYMON012	g20728	BLASTN	670	1e-47	81
2585	1061	700788840H2	SOYMON011	g20728	BLASTN	676	1e-47	87
2586	1061	700741626H1	SOYMON012	g20728	BLASTN	676	1e-47	87
2587	1061	700789225H2	SOYMON011	g20728	BLASTN	339	1e-46	87
2588	1061	700548027H1	SOYMON001	g20728	BLASTN	368	1e-46	88
2589	1061	701070385H1	SOYMON034	g20728	BLASTN	370	1e-46	87
2590	1061	700681469H2	SOYMON008	g20728	BLASTN	411	1e-46	85
2591	1061	700548037H1	SOYMON001	g20728	BLASTN	526	1e-46	87
2592	1061	700646084H1	SOYMON011	g12158	BLASTN	564	1e-46	79
2593	1061	700752275H1	SOYMON014	g20728	BLASTN	629	1e-46	85
2594	1061	700683806H1	SOYMON008	g20728	BLASTN	660	1e-46	88
2595	1061	700654909H1	SOYMON004	g12158	BLASTN	666	1e-46	80
2596	1061	700986823H1	SOYMON009	g20728	BLASTN	667	1e-46	81
2597	1061	700741156H1	SOYMON012	g20728	BLASTN	304	1e-45	87
2598	1061	700906879H1	SOYMON022	g20728	BLASTN	398	1e-45	85
2599	1061	700875004H1	SOYMON018	g12158	BLASTN	647	1e-45	86
2600	1061	700996131H1	SOYMON018	g20728	BLASTN	648	1e-45	86
2601	1061	700873575H1	SOYMON018	g20728	BLASTN	648	1e-45	81
2602	1061	700990142H1	SOYMON011	g20728	BLASTN	648	1e-45	86
2603	1061	700981885H1	SOYMON009	g12158	BLASTN	651	1e-45	80
2604	1061	700874783H1	SOYMON018	g20728	BLASTN	653	1e-45	86
2605	1061	701110202H1	SOYMON036	g20728	BLASTN	656	1e-45	81
2606	1061	700683388H1	SOYMON008	g20728	BLASTN	640	1e-44	84
2607	1061	700875643H1	SOYMON018	g20728	BLASTN	643	1e-44	85
2608	1061	701001467H1	SOYMON018	g20728	BLASTN	414	1e-43	83
2609	1061	700787152H2	SOYMON011	g20728	BLASTN	428	1e-43	82
2610	1061	700683930H1	SOYMON008	g20728	BLASTN	339	1e-42	86
2611	1061	700740930H1	SOYMON012	g20728	BLASTN	367	1e-42	85
2612	1061	700787113H2	SOYMON011	g20728	BLASTN	394	1e-42	78
2613	1061	700739178H1	SOYMON012	g20728	BLASTN	415	1e-42	86
2614	1061	700986609H1	SOYMON009	g20728	BLASTN	529	1e-42	85
2615	1061	700683409H1	SOYMON008	g12158	BLASTN	582	1e-42	81
2616	1061	700743479H1	SOYMON012	g20728	BLASTN	545	1e-41	87
2617	1061	700681635H1	SOYMON008	g20728	BLASTN	553	1e-41	80
2618	1061	701109104H1	SOYMON036	g12158	BLASTN	596	1e-40	81

2629	1061	700975280H1	SOYMON009	g20728	BLASTN	517	1e-34	75
2630	1061	700788092H1	SOYMON011	g20728	BLASTN	264	1e-33	78
2631	1061	700683952H1	SOYMON008	g20728	BLASTN	364	1e-33	88
2632	1061	700992834H1	SOYMON011	g20728	BLASTN	380	1e-33	89
2633	1061	700991505H1	SOYMON011	g20728	BLASTN	460	1e-33	77
2634	1061	701110056H1	SOYMON036	g20728	BLASTN	490	1e-32	88
2635	1061	700679803H1	SOYMON007	g20728	BLASTN	490	1e-32	88
2636	1061	700686648H1	SOYMON008	g20728	BLASTN	483	1e-31	87
2637	1061	701000893H1	SOYMON018	g12158	BLASTN	253	1e-30	90
2638	1061	700729743H1	SOYMON009	g12158	BLASTN	362	1e-30	82
2639	1061	700656983H1	SOYMON004	g12158	BLASTN	379	1e-30	81
2640	1061	700742961H1	SOYMON012	g166701	BLASTN	469	1e-30	80
2641	1061	700995207H1	SOYMON011	g20728	BLASTN	322	1e-28	86
2642	1061	700960745H1	SOYMON022	g20728	BLASTN	444	1e-28	73
2643	1061	700873668H1	SOYMON018	g12158	BLASTN	337	1e-27	76
2644	1061	700991519H1	SOYMON011	g166701	BLASTN	435	1e-27	88
2645	1061	700743185H1	SOYMON012	g20728	BLASTN	427	1e-26	88
2646	1061	700554408H1	SOYMON001	g12158	BLASTN	221	1e-25	77
2647	1061	700686096H1	SOYMON008	g12158	BLASTN	326	1e-24	78
2648	1061	700739363H1	SOYMON012	g20728	BLASTN	401	1e-24	89
2649	1061	700996585H1	SOYMON018	g20728	BLASTN	416	1e-24	84
2650	1061	700991823H1	SOYMON011	g20728	BLASTN	422	1e-24	78
2651	1061	701000661H1	SOYMON018	g166702	BLASTX	130	1e-23	74
2652	1061	700606165H2	SOYMON008	g20728	BLASTN	389	1e-23	90
2653	1061	700999082H1	SOYMON018	g12158	BLASTN	364	1e-22	81
2654	1061	700738051H1	SOYMON012	g20728	BLASTN	376	1e-22	93
2655	1061	700740881H1	SOYMON012	g20728	BLASTN	377	1e-22	92
2656	1061	700987548H1	SOYMON009	g20728	BLASTN	347	1e-21	91
2657	1061	700739359H1	SOYMON012	g20728	BLASTN	357	1e-20	90
2658	1061	700979451H1	SOYMON009	g20728	BLASTN	357	1e-20	88
2659	1061	700991851H1	SOYMON011	g20728	BLASTN	351	1e-18	84
2660	1061	700989348H1	SOYMON011	g20728	BLASTN	295	1e-14	85
2661	1061	700558380H1	SOYMON001	g12159	BLASTX	80	1e-12	81
2662	1061	700738070H1	SOYMON012	g12158	BLASTN	160	1e-10	85
2663	1061	700992942H1	SOYMON011	g20728	BLASTN	243	1e-9	94
2664	1061	700986029H1	SOYMON009	g20728	BLASTN	208	1e-8	76
2665	1061	700743737H1	SOYMON012	g20728	BLASTN	231	1e-8	84
2666	12847	700680701H1	SOYMON008	g20732	BLASTN	547	1e-35	87
2667	12847	700874711H1	SOYMON018	g20732	BLASTN	486	1e-31	87
2668	1392	701051645H1	SOYMON032	g2078297	BLASTN	1065	1e-80	86
2669	1392	700563915H1	SOYMON002	g2078297	BLASTN	1072	1e-80	88
2670	1392	701204320H2	SOYMON035	g2078297	BLASTN	1005	1e-75	88
2671	1392	700652968H1	SOYMON003	g19565	BLASTN	1012	1e-75	83
2672	1392	700748683H1	SOYMON013	g169090	BLASTN	968	1e-71	86
2673	1392	700981771H1	SOYMON009	g2078297	BLASTN	552	1e-70	88
2674	1392	700605826H2	SOYMON006	g21142	BLASTN	618	1e-68	85
2675	1392	700666839H1	SOYMON005	g2078297	BLASTN	809	1e-68	88
2676	1392	700944037H1	SOYMON024	g19565	BLASTN	899	1e-66	83
2677	1392	700969575H1	SOYMON005	g19565	BLASTN	854	1e-62	83
2678	1392	701118935H1	SOYMON037	g19565	BLASTN	838	1e-61	83
2679	1392	700725758H1	SOYMON009	g19565	BLASTN	846	1e-61	81
2680	1392	701054027H1	SOYMON032	g19565	BLASTN	818	1e-59	83
2681	1392	700954591H1	SOYMON022	g19565	BLASTN	825	1e-59	83
2682	1392	700653724H1	SOYMON003	g19565	BLASTN	781	1e-56	83

2683	1392	701052969H1	SOYMON032	g19565	BLASTN	788	1e-56	82
2684	1392	700836192H1	SOYMON019	g19565	BLASTN	769	1e-55	84
2685	1392	701014006H1	SOYMON019	g19565	BLASTN	769	1e-55	84
2686	1392	700849014H1	SOYMON021	g19565	BLASTN	770	1e-55	83
2687	1392	700747177H1	SOYMON013	g19565	BLASTN	770	1e-55	83
2688	1392	700733933H1	SOYMON010	g19565	BLASTN	775	1e-55	83
2689	1392	701045883H1	SOYMON032	g19565	BLASTN	754	1e-54	83
2690	1392	700561161H1	SOYMON002	g19565	BLASTN	760	1e-54	83
2691	1392	701002757H2	SOYMON019	g19565	BLASTN	764	1e-54	84
2692	1392	701150827H1	SOYMON031	g21142	BLASTN	428	1e-53	88
2693	1392	701043855H1	SOYMON032	g19565	BLASTN	432	1e-53	84
2694	1392	701138753H1	SOYMON038	g166705	BLASTN	395	1e-52	80
2695	1392	700746913H1	SOYMON013	g19565	BLASTN	596	1e-52	84
2696	1392	701004953H1	SOYMON019	g19565	BLASTN	734	1e-52	83
2697	1392	700900882H1	SOYMON027	g19565	BLASTN	740	1e-52	83
2698	1392	700987148H1	SOYMON009	g19565	BLASTN	691	1e-51	83
2699	1392	701054872H1	SOYMON032	g19565	BLASTN	719	1e-51	81
2700	1392	701056763H1	SOYMON032	g166705	BLASTN	632	1e-50	83
2701	1392	700748607H1	SOYMON013	g19565	BLASTN	707	1e-50	82
2702	1392	700830473H1	SOYMON019	g19565	BLASTN	694	1e-49	83
2703	1392	700762033H1	SOYMON015	g19565	BLASTN	696	1e-49	82
2704	1392	700987949H1	SOYMON009	g19565	BLASTN	700	1e-49	83
2705	1392	701135194H1	SOYMON038	g19565	BLASTN	705	1e-49	82
2706	1392	700748676H1	SOYMON013	g19565	BLASTN	379	1e-48	83
2707	1392	701046095H1	SOYMON032	g166705	BLASTN	386	1e-48	83
2708	1392	701045383H1	SOYMON032	g21142	BLASTN	623	1e-48	82
2709	1392	701052575H1	SOYMON032	g19565	BLASTN	683	1e-48	83
2710	1392	700667935H1	SOYMON006	g19565	BLASTN	690	1e-48	82
2711	1392	701055287H1	SOYMON032	g19565	BLASTN	690	1e-48	80
2712	1392	700660946H1	SOYMON005	g19565	BLASTN	691	1e-48	82
2713	1392	700891889H1	SOYMON024	g19565	BLASTN	670	1e-47	82
2714	1392	700670279H1	SOYMON006	g19565	BLASTN	672	1e-47	83
2715	1392	700865105H1	SOYMON016	g21142	BLASTN	674	1e-47	82
2716	1392	700664974H1	SOYMON005	g19565	BLASTN	677	1e-47	83
2717	1392	700727084H1	SOYMON009	g19565	BLASTN	680	1e-47	82
2718	1392	700748807H1	SOYMON013	g19565	BLASTN	628	1e-46	80
2719	1392	700749971H1	SOYMON013	g21142	BLASTN	662	1e-46	81
2720	1392	700664177H1	SOYMON005	g19565	BLASTN	657	1e-45	83
2721	1392	700969206H1	SOYMON005	g166705	BLASTN	634	1e-44	84
2722	1392	700668696H1	SOYMON006	g19565	BLASTN	636	1e-44	83
2723	1392	700677777H1	SOYMON007	g19565	BLASTN	640	1e-44	83
2724	1392	700969506H1	SOYMON005	g21142	BLASTN	642	1e-44	81
2725	1392	700667829H1	SOYMON006	g166705	BLASTN	643	1e-44	82
2726	1392	700730321H1	SOYMON009	g166705	BLASTN	643	1e-44	82</

2737	1392	700726201H1	SOYMON009	g19565	BLASTN	454	1e-41	81
2738	1392	701004758H1	SOYMON019	g166705	BLASTN	544	1e-41	83
2739	1392	701047055H1	SOYMON032	g166705	BLASTN	599	1e-41	85
2740	1392	700970781H1	SOYMON005	g166705	BLASTN	604	1e-41	83
2741	1392	700726274H1	SOYMON009	g19565	BLASTN	442	1e-40	82
2742	1392	701011762H1	SOYMON019	g166705	BLASTN	287	1e-39	79
2743	1392	700669086H1	SOYMON006	g21142	BLASTN	460	1e-39	83
2744	1392	700833089H1	SOYMON019	g166705	BLASTN	472	1e-39	82
2745	1392	700745795H1	SOYMON013	g19565	BLASTN	576	1e-39	76
2746	1392	700651350H1	SOYMON003	g166705	BLASTN	567	1e-38	83
2747	1392	700748761H1	SOYMON013	g166705	BLASTN	556	1e-37	83
2748	1392	701012075H1	SOYMON019	g166705	BLASTN	558	1e-37	84
2749	1392	700564585H1	SOYMON002	g21065	BLASTN	309	1e-36	85
2750	1392	701051053H1	SOYMON032	g166705	BLASTN	543	1e-36	84
2751	1392	700661104H1	SOYMON005	g166705	BLASTN	544	1e-35	85
2752	1392	701051845H1	SOYMON032	g19565	BLASTN	501	1e-32	84
2753	1392	700748992H1	SOYMON013	g21142	BLASTN	374	1e-22	82
2754	1392	700845656H1	SOYMON021	g166705	BLASTN	391	1e-22	83
2755	1392	700988562H1	SOYMON009	g1184773	BLASTN	397	1e-22	83
2756	1392	701003233H1	SOYMON019	g166705	BLASTN	249	1e-20	83
2757	1392	701048025H1	SOYMON032	g166705	BLASTN	335	1e-19	84
2758	14902	700977778H1	SOYMON009	g496493	BLASTN	1158	1e-87	90
2759	14902	700742004H1	SOYMON012	g496493	BLASTN	618	1e-81	90
2760	14902	700962586H1	SOYMON022	g496493	BLASTN	1023	1e-76	90
2761	14902	700994796H1	SOYMON011	g496493	BLASTN	480	1e-59	86
2762	16	700680820H1	SOYMON008	g169090	BLASTN	1392	1e-107	90
2763	16	700651027H1	SOYMON003	g169090	BLASTN	782	1e-101	87
2764	16	700661720H1	SOYMON005	g169090	BLASTN	1280	1e-98	84
2765	16	700653620H1	SOYMON003	g169090	BLASTN	783	1e-92	86
2766	16	701212010H1	SOYMON035	g169090	BLASTN	1193	1e-90	90
2767	16	700653624H1	SOYMON003	g169090	BLASTN	711	1e-86	86
2768	16	700684013H1	SOYMON008	g20732	BLASTN	1139	1e-86	89
2769	16	701130927H1	SOYMON038	g169090	BLASTN	1135	1e-85	90
2770	16	701118656H1	SOYMON037	g169090	BLASTN	927	1e-83	90
2771	16	701050807H1	SOYMON032	g169090	BLASTN	1101	1e-83	90
2772	16	700900304H1	SOYMON027	g169090	BLASTN	1108	1e-83	91
2773	16	700560856H1	SOYMON001	g20732	BLASTN	594	1e-82	88
2774	16	701127846H1	SOYMON037	g169090	BLASTN	1093	1e-82	90
2775	16	700746107H1	SOYMON013	g169090	BLASTN	1093	1e-82	91
2776	16	700957321H1	SOYMON022	g169090	BLASTN	1094	1e-82	90
2777	16	700556167H1	SOYMON001	g20732	BLASTN	1094	1e-82	87
2778	16	700685605H1	SOYMON008	g20732	BLASTN	1095	1e-82	89
2779	16	700982024H1	SOYMON009	g169090	BLASTN	1097	1e-82	87
2780	16	701136318H1	SOYMON038	g169090	BLASTN	912	1e-81	90
2781	16	701045985H1	SOYMON032	g169090	BLASTN	1083	1e-81	91
2782	16	700896756H1	SOYMON027	g169090	BLASTN	1083	1e-81	89
2783	16	700738664H1	SOYMON012	g20732	BLASTN	1087	1e-81	89
2784	16	700982290H1	SOYMON009	g169090	BLASTN	1088	1e-81	88
2785	16	701039411H1	SOYMON029	g169090	BLASTN	1068	1e-80	88
2786	16	700760151H1	SOYMON015	g169090	BLASTN	1076	1e-80	87
2787	16	701037105H1	SOYMON029	g169090	BLASTN	706	1e-79	90
2788	16	700653646H1	SOYMON003	g169090	BLASTN	723	1e-79	83
2789	16	701003361H1	SOYMON019	g169090	BLASTN	913	1e-79	88
2790	16	700684871H1	SOYMON008	g169090	BLASTN	1058	1e-79	90

2791	16	700972333H1	SOYMON005	g169090	BLASTN	1059	1e-79	89
2792	16	700660117H1	SOYMON004	g20732	BLASTN	1060	1e-79	91
2793	16	700681841H1	SOYMON008	g169090	BLASTN	1060	1e-79	89
2794	16	701063487H1	SOYMON033	g169090	BLASTN	1063	1e-79	87
2795	16	701118518H1	SOYMON037	g169090	BLASTN	1064	1e-79	92
2796	16	700998228H1	SOYMON018	g169090	BLASTN	599	1e-78	91
2797	16	700667222H1	SOYMON006	g169090	BLASTN	1042	1e-78	87
2798	16	701205378H1	SOYMON035	g169090	BLASTN	1047	1e-78	89
2799	16	701109009H1	SOYMON036	g169090	BLASTN	1050	1e-78	85
2800	16	700902080H1	SOYMON027	g20732	BLASTN	1051	1e-78	88
2801	16	701065402H1	SOYMON034	g20732	BLASTN	1051	1e-78	85
2802	16	700905151H1	SOYMON022	g169090	BLASTN	1052	1e-78	89
2803	16	700660104H1	SOYMON004	g20732	BLASTN	1053	1e-78	91
2804	16	701122747H1	SOYMON037	g169090	BLASTN	1029	1e-77	85
2805	16	700681958H1	SOYMON008	g20732	BLASTN	1033	1e-77	87
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2807	16	700870706H1	SOYMON018	g169090	BLASTN	1038	1e-77	89
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2809	16	700981914H1	SOYMON009	g169090	BLASTN	455	1e-76	83
2810	16	700873416H1	SOYMON018	g20732	BLASTN	544	1e-76	88
2811	16	700562964H1	SOYMON002	g169090	BLASTN	824	1e-76	88
2812	16	700829678H1	SOYMON019	g169090	BLASTN	1021	1e-76	88
2813	16	700668218H1	SOYMON006	g20732	BLASTN	1023	1e-76	87
2814	16	701206845H1	SOYMON035	g169090	BLASTN	1024	1e-76	90
2815	16	700835082H1	SOYMON019	g169090	BLASTN	1024	1e-76	88
2816	16	701011483H1	SOYMON019	g169090	BLASTN	1024	1e-76	90
2817	16	700605436H2	SOYMON004	g20732	BLASTN	1027	1e-76	86
2818	16	700963428H1	SOYMON022	g20732	BLASTN	1027	1e-76	89
2819	16	700975672H1	SOYMON009	g20732	BLASTN	852	1e-75	90
2820	16	700907957H1	SOYMON022	g169090	BLASTN	1005	1e-75	91
2821	16	700960608H1	SOYMON022	g169090	BLASTN	1005	1e-75	88
2822	16	700837794H1	SOYMON020	g169090	BLASTN	1006	1e-75	91
2823	16	701138460H1	SOYMON038	g169090	BLASTN	1006	1e-75	88
2824	16	700646202H1	SOYMON012	g20732	BLASTN	1007	1e-75	88
2825	16	700874447H1	SOYMON018	g20732	BLASTN	1007	1e-75	90
2826	16	700667967H1	SOYMON006	g20732	BLASTN	1007	1e-75	89
2827	16	701131790H1	SOYMON038	g169090	BLASTN	1011	1e-75	91
2828	16	700970954H1	SOYMON005	g169090	BLASTN	1012	1e-75	87
2829	16	701120441H1	SOYMON037	g169090	BLASTN	1013	1e-75	87
2830	16	701120055H1	SOYMON037	g169090	BLASTN	1015	1e-75	83
2831	16	701001031H1	SOYMON018	g20732	BLASTN	1017	1e-75	83
2832	16	700652931H1	SOYMON003	g169090	BLASTN	853	1e-74	79
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2835	16	700978682H1	SOYMON009	g169090	BLASTN	1000	1e-74	85
2836	16	701122065H1	SOYMON037	g169090	BLASTN	1004	1e-74	87
2837	16	700558895H1	SOYMON001	g20732	BLASTN	566	1e-73	86
2838	16	700686234H1	SOYMON008	g20732	BLASTN	573	1e-73	89
2839	16	700566271H1	SOYMON002	g169090	BLASTN	863	1e-73	84
2840	16	700558604H1	SOYMON001	g20732	BLASTN	982	1e-73	82
2841	16	700684166H1	SOYMON008	g169090	BLASTN	984	1e-73	86
2842	16	700873924H1	SOYMON018	g169090	BLASTN	986	1e-73	88
2843	16	700738880H1	SOYMON012	g20732	BLASTN	987	1e-73	89
2844	16	700741816H1	SOYMON012	g20732	BLASTN	992	1e-73	86



2845	16	700892371H1	SOYMON024	g169090	BLASTN	992	1e-73	88
2846	16	700560702H1	SOYMON001	g20732	BLASTN	993	1e-73	82
2847	16	700968331H1	SOYMON036	g20732	BLASTN	993	1e-73	88
2848	16	701063318H1	SOYMON033	g169090	BLASTN	787	1e-72	88
2849	16	700996472H1	SOYMON018	g20732	BLASTN	821	1e-72	86
2850	16	701065057H1	SOYMON034	g169090	BLASTN	924	1e-72	84
2851	16	700863670H1	SOYMON027	g169090	BLASTN	943	1e-72	90
2852	16	701212013H1	SOYMON035	g169090	BLASTN	969	1e-72	85
2853	16	701012801H1	SOYMON019	g169090	BLASTN	969	1e-72	85
2854	16	701004406H1	SOYMON019	g169090	BLASTN	969	1e-72	85
2855	16	700751116H1	SOYMON014	g169090	BLASTN	970	1e-72	90
2856	16	700675491H1	SOYMON007	g169090	BLASTN	972	1e-72	92
2857	16	701131360H1	SOYMON038	g169090	BLASTN	972	1e-72	84
2858	16	700562740H1	SOYMON002	g169090	BLASTN	976	1e-72	83
2859	16	701099556H1	SOYMON028	g169090	BLASTN	979	1e-72	88
2860	16	700558534H1	SOYMON001	g20732	BLASTN	469	1e-71	84
2861	16	700565245H1	SOYMON002	g169090	BLASTN	715	1e-71	90
2862	16	700944452H1	SOYMON024	g169090	BLASTN	780	1e-71	86
2863	16	701009629H1	SOYMON019	g169090	BLASTN	828	1e-71	84
2864	16	700725661H1	SOYMON009	g169090	BLASTN	838	1e-71	87
2865	16	701066885H1	SOYMON034	g169090	BLASTN	856	1e-71	86
2866	16	701009856H1	SOYMON019	g169090	BLASTN	958	1e-71	83
2867	16	700560569H1	SOYMON001	g169090	BLASTN	963	1e-71	84
2868	16	700867802H1	SOYMON016	g169090	BLASTN	964	1e-71	85
2869	16	701117421H1	SOYMON037	g169090	BLASTN	967	1e-71	83
2870	16	700963317H1	SOYMON022	g20732	BLASTN	830	1e-70	85
2871	16	700646149H1	SOYMON012	g20732	BLASTN	864	1e-70	87
2872	16	701002213H1	SOYMON018	g20732	BLASTN	946	1e-70	88
2873	16	700999509H1	SOYMON018	g20732	BLASTN	948	1e-70	83
2874	16	701003210H1	SOYMON019	g169090	BLASTN	949	1e-70	83
2875	16	700738832H1	SOYMON012	g20732	BLASTN	952	1e-70	86
2876	16	701212329H1	SOYMON035	g169090	BLASTN	952	1e-70	85
2877	16	700683783H1	SOYMON008	g169090	BLASTN	953	1e-70	83
2878	16	700874828H1	SOYMON018	g20732	BLASTN	953	1e-70	85
2879	16	700839986H1	SOYMON020	g169090	BLASTN	954	1e-70	89
2880	16	700661155H1	SOYMON005	g169090	BLASTN	955	1e-70	84
2881	16	700686453H1	SOYMON008	g20732	BLASTN	956	1e-70	85
2882	16	701104636H1	SOYMON036	g169090	BLASTN	956	1e-70	84
2883	16	700682277H1	SOYMON008	g20732	BLASTN	444	1e-69	88
2884	16	700556648H1	SOYMON001	g20732	BLASTN	526	1e-69	83
2885	16	701133126H1	SOYMON038	g169090	BLASTN	526	1e-69	86
2886	16	700659056H1	SOYMON004	g169090	BLASTN	655	1e-69	91
2887	16	701009405H1	SOYMON019	g169090	BLASTN	665	1e-69	91
2888	16	700554721H1	SOYMON001	g169090	BLASTN	743	1e-69	81
2889	16	700833925H1	SOYMON019	g169090				

2899	16	700681390H2	SOYMON008	g20732	BLASTN	506	1e-67	88
2900	16	700554330H1	SOYMON001	g20732	BLASTN	794	1e-67	83
2901	16	700746738H1	SOYMON013	g169090	BLASTN	910	1e-67	86
2902	16	700962884H1	SOYMON022	g169090	BLASTN	919	1e-67	85
2903	16	700683756H1	SOYMON008	g20732	BLASTN	919	1e-67	83
2904	16	700898676H1	SOYMON027	g169090	BLASTN	919	1e-67	91
2905	16	700685076H1	SOYMON008	g20732	BLASTN	921	1e-67	85
2906	16	700836262H1	SOYMON019	g169090	BLASTN	898	1e-66	84
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2908	16	700967318H1	SOYMON031	g20732	BLASTN	906	1e-66	85
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2912	16	700979861H2	SOYMON009	g169090	BLASTN	293	1e-65	88
2913	16	700907981H1	SOYMON022	g20550	BLASTN	681	1e-65	85
2914	16	701001058H1	SOYMON018	g20732	BLASTN	690	1e-65	81
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2916	16	700678780H1	SOYMON007	g169090	BLASTN	854	1e-65	92
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2918	16	701099668H1	SOYMON028	g169090	BLASTN	493	1e-64	83
2919	16	701103733H1	SOYMON036	g169090	BLASTN	684	1e-64	80
2920	16	700985604H1	SOYMON009	g169090	BLASTN	873	1e-64	79
2921	16	700849622H1	SOYMON021	g169090	BLASTN	877	1e-64	84
2922	16	700752648H1	SOYMON014	g169090	BLASTN	879	1e-64	85
2923	16	700952882H1	SOYMON022	g20732	BLASTN	884	1e-64	85
2924	16	701006721H1	SOYMON019	g169090	BLASTN	884	1e-64	86
2925	16	700895879H1	SOYMON027	g169090	BLASTN	884	1e-64	84
2926	16	700740632H1	SOYMON012	g20732	BLASTN	375	1e-63	84
2927	16	700981723H1	SOYMON009	g20732	BLASTN	690	1e-63	81
2928	16	700657114H1	SOYMON004	g169090	BLASTN	861	1e-63	87
2929	16	700661319H1	SOYMON005	g169090	BLASTN	862	1e-63	82
2930	16	700987848H1	SOYMON009	g169090	BLASTN	862	1e-63	79
2931	16	700664376H1	SOYMON005	g169090	BLASTN	865	1e-63	83
2932	16	700848760H1	SOYMON021	g169090	BLASTN	868	1e-63	82
2933	16	700734932H1	SOYMON010	g169090	BLASTN	871	1e-63	90
2934	16	700894550H1	SOYMON024	g169090	BLASTN	872	1e-63	86
2935	16	700754237H1	SOYMON014	g169090	BLASTN	443	1e-62	83
2936	16	700654194H1	SOYMON003	g169090	BLASTN	449	1e-62	83
2937	16	701002119H1	SOYMON018	g20732	BLASTN	459	1e-62	89
2938	16	700899445H1	SOYMON027	g20732	BLASTN	473	1e-62	86
2939	16	700648324H1	SOYMON003	g169090	BLASTN	531	1e-62	80
2940	16	700897837H1	SOYMON027	g169090	BLASTN	582	1e-62	82
2941	16	701056234H1	SOYMON032	g169090	BLASTN	737	1e-62	79
2942	16	700906196H1	SOYMON022	g169090	BLASTN	852	1e-62	83
2943	16	701002126H1	SOYMON018	g20732	BLASTN</			

2953	16	701133107H1	SOYMON038	g169090	BLASTN	845	1e-61	79
2954	16	700976170H1	SOYMON009	g169090	BLASTN	848	1e-61	78
2955	16	700646259H1	SOYMON012	g20732	BLASTN	650	1e-60	82
2956	16	700682750H1	SOYMON008	g169090	BLASTN	654	1e-60	83
2957	16	700556141H1	SOYMON001	g20732	BLASTN	690	1e-60	81
2958	16	700870652H1	SOYMON018	g20732	BLASTN	702	1e-60	86
2959	16	700893834H1	SOYMON024	g169090	BLASTN	826	1e-60	82
2960	16	700970819H1	SOYMON005	g169090	BLASTN	828	1e-60	81
2961	16	700890650H1	SOYMON024	g169090	BLASTN	830	1e-60	88
2962	16	701122211H1	SOYMON037	g169090	BLASTN	830	1e-60	83
2963	16	700980742H1	SOYMON009	g169090	BLASTN	830	1e-60	84
2964	16	701137606H1	SOYMON038	g169090	BLASTN	832	1e-60	83
2965	16	700682612H2	SOYMON008	g20732	BLASTN	834	1e-60	81
2966	16	700971830H1	SOYMON005	g169090	BLASTN	835	1e-60	79
2967	16	700909405H1	SOYMON022	g169090	BLASTN	835	1e-60	79
2968	16	700981291H1	SOYMON009	g169090	BLASTN	835	1e-60	79
2969	16	700953564H1	SOYMON022	g169090	BLASTN	836	1e-60	82
2970	16	700747612H1	SOYMON013	g409574	BLASTN	836	1e-60	83
2971	16	700975021H1	SOYMON005	g169090	BLASTN	439	1e-59	82
2972	16	700729321H1	SOYMON009	g309670	BLASTN	485	1e-59	81
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2974	16	700554280H1	SOYMON001	g20732	BLASTN	596	1e-59	88
2975	16	701135387H1	SOYMON038	g169090	BLASTN	609	1e-59	80
2976	16	700655905H1	SOYMON004	g169090	BLASTN	646	1e-59	82
2977	16	701048613H1	SOYMON032	g169090	BLASTN	814	1e-59	79
2978	16	701062603H1	SOYMON033	g166705	BLASTN	814	1e-59	83
2979	16	700741884H1	SOYMON012	g169090	BLASTN	815	1e-59	83
2980	16	701014048H1	SOYMON019	g169090	BLASTN	815	1e-59	84
2981	16	700556774H1	SOYMON001	g20732	BLASTN	817	1e-59	82
2982	16	701212143H1	SOYMON035	g169090	BLASTN	819	1e-59	79
2983	16	700977724H1	SOYMON009	g169090	BLASTN	819	1e-59	83
2984	16	701052505H1	SOYMON032	g169090	BLASTN	821	1e-59	84
2985	16	701048090H1	SOYMON032	g169090	BLASTN	823	1e-59	85
2986	16	700850111H1	SOYMON023	g169090	BLASTN	802	1e-58	80
2987	16	700748768H1	SOYMON013	g169090	BLASTN	804	1e-58	85
2988	16	701215404H1	SOYMON035	g169090	BLASTN	806	1e-58	84
2989	16	700686206H1	SOYMON008	g20732	BLASTN	807	1e-58	82
2990	16	701137704H1	SOYMON038	g409574	BLASTN	808	1e-58	82
2991	16	700876594H1	SOYMON018	g169090	BLASTN	809	1e-58	83
2992	16	700743816H1	SOYMON012	g20732	BLASTN	809	1e-58	90
2993	16	701037342H1	SOYMON029	g409574	BLASTN	812	1e-58	82
2994	16	700853152H1	SOYMON023	g169090	BLASTN	576	1e-57	87
2995	16	700905876H1	SOYMON022	g169090	BLASTN	606	1e-57	84
2996	16	700790719H1	SOYMON011	g409574	BLASTN	710	1e-57	82
2997	16	701106994H1	SOYMON036	g169090	BLASTN	790	1e-57	79
2998	16	700752366H1	SOYMON014	g169090	BLASTN	790	1e-57	81
2999	16	700952951H1	SOYMON022	g169090	BLASTN	791	1e-57	84
3000	16	700998563H1	SOYMON018	g20732	BLASTN	792	1e-57	88
3001	16	700840245H1	SOYMON020	g169090	BLASTN	792	1e-57	79
3002	16	700556140H1	SOYMON001	g166705	BLASTN	794	1e-57	82
3003	16	701056981H1	SOYMON033	g169090	BLASTN	795	1e-57	83
3004	16	700953045H1	SOYMON022	g169090	BLASTN	796	1e-57	83
3005	16	701137408H1	SOYMON038	g169090	BLASTN	797	1e-57	82
3006	16	700972258H1	SOYMON005	g169090	BLASTN	797	1e-57	79

3007	16	700980774H1	SOYMON009	g169090	BLASTN	797	1e-57	88
3008	16	700972064H1	SOYMON005	g169090	BLASTN	797	1e-57	79
3009	16	700685812H1	SOYMON008	g169090	BLASTN	798	1e-57	79
3010	16	700740477H1	SOYMON012	g409574	BLASTN	801	1e-57	84
3011	16	701062012H1	SOYMON033	g409574	BLASTN	451	1e-56	82
3012	16	701108736H1	SOYMON036	g20732	BLASTN	529	1e-56	80
3013	16	701104521H1	SOYMON036	g169090	BLASTN	680	1e-56	84
3014	16	700659833H1	SOYMON004	g2905771	BLASTN	754	1e-56	97
3015	16	700786076H2	SOYMON011	g2905771	BLASTN	754	1e-56	97
3016	16	700666231H1	SOYMON005	g2905771	BLASTN	754	1e-56	97
3017	16	700556330H1	SOYMON001	g20732	BLASTN	779	1e-56	81
3018	16	700964614H1	SOYMON022	g19565	BLASTN	780	1e-56	84
3019	16	700985844H1	SOYMON009	g19565	BLASTN	780	1e-56	84
3020	16	701126134H1	SOYMON037	g409574	BLASTN	781	1e-56	83
3021	16	700968036H1	SOYMON034	g169090	BLASTN	786	1e-56	85
3022	16	701110182H1	SOYMON036	g169090	BLASTN	786	1e-56	85
3023	16	700995174H1	SOYMON011	g169090	BLASTN	787	1e-56	85
3024	16	701044955H1	SOYMON032	g2905771	BLASTN	404	1e-55	96
3025	16	701203714H2	SOYMON035	g2905771	BLASTN	413	1e-55	97
3026	16	700847062H1	SOYMON021	g169090	BLASTN	528	1e-55	83
3027	16	700876923H1	SOYMON018	g20732	BLASTN	568	1e-55	81
3028	16	700738183H1	SOYMON012	g20732	BLASTN	586	1e-55	81
3029	16	701001383H1	SOYMON018	g20732	BLASTN	590	1e-55	81
3030	16	700877113H1	SOYMON018	g20732	BLASTN	681	1e-55	80
3031	16	700562672H1	SOYMON002	g169090	BLASTN	693	1e-55	83
3032	16	700956242H1	SOYMON022	g2905771	BLASTN	740	1e-55	96
3033	16	701058012H1	SOYMON033	g2905771	BLASTN	747	1e-55	96
3034	16	701070207H1	SOYMON034	g2905771	BLASTN	747	1e-55	96
3035	16	700901724H1	SOYMON027	g2905771	BLASTN	747	1e-55	96
3036	16	700792920H1	SOYMON017	g169090	BLASTN	767	1e-55	83
3037	16	700964732H1	SOYMON022	g169090	BLASTN	768	1e-55	84
3038	16	700994809H1	SOYMON011	g409574	BLASTN	768	1e-55	83
3039	16	700987118H1	SOYMON009	g19565	BLASTN	769	1e-55	84
3040	16	701007268H2	SOYMON019	g169090	BLASTN	769	1e-55	83
3041	16	700650971H1	SOYMON003	g169090	BLASTN	770	1e-55	91
3042	16	700964742H1	SOYMON022	g169090	BLASTN	771	1e-55	85
3043	16	700662524H1	SOYMON005	g169090	BLASTN	772	1e-55	79
3044	16	700895349H1	SOYMON027	g20732	BLASTN	772	1e-55	89
3045	16	701008593H1	SOYMON019	g169090	BLASTN	776	1e-55	82
3046	16	701004062H1	SOYMON019	g169090	BLASTN	326	1e-54	81
3047	16	700731710H1	SOYMON010	g169090	BLASTN	456	1e-54	84
3048	16	700742019H1	SOYMON012	g409574	BLASTN	483	1e-54	83
3049	16	700944396H1	SOYMON024	g169090	BLASTN	610	1e-54	84
3050	16	701139717H1	SOYMON038	g169090	BLASTN	639	1e-54	81
3051	16	700555467H1	SOYMON001	g20732	BLASTN	688	1e-54	81
3052	16	701041622H1	SOYMON029	g2905771	BLASTN	738	1e-54	96
3053	16	700736350H1	SOYMON010	g409574	BLASTN	754	1e-54	83
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3067	16	700740171H1	SOYMON012	g169090	BLASTN	749	1e-53	83
3068	16	700875936H1	SOYMON018	g20732	BLASTN	400	1e-52	84
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3070	16	701064163H1	SOYMON034	g169090	BLASTN	519	1e-52	85
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3074	16	700741593H1	SOYMON012	g409574	BLASTN	707	1e-52	83
3075	16	700792328H1	SOYMON017	g2905771	BLASTN	715	1e-52	100
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3078	16	700732002H1	SOYMON010	g169090	BLASTN	732	1e-52	77
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3093	16	700737167H1	SOYMON010	g20550	BLASTN	474	1e-51	83
3094	16	700792472H1	SOYMON017	g409574	BLASTN	489	1e-51	84
3095	16	701002831H1	SOYMON019	g409574	BLASTN	495	1e-51	83
3096	16	701147120H1	SOYMON031	g169090	BLASTN	592	1e-51	86
3097	16	700993103H1	SOYMON011	g409574	BLASTN	679	1e-51	81
3098	16	700681212H1	SOYMON008	g20732	BLASTN	684	1e-51	82
3099	16	700787050H2	SOYMON011	g20732	BLASTN	722	1e-51	82
3100	16	700964087H1	SOYMON022	g169090	BLASTN	723	1e-51	83
3101	16	701131690H1	SOYMON038	g169090	BLASTN	724	1e-51	80
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3106	16	700786782H2	SOYMON011	g169090	BLASTN	728	1e-51	79
3107	16	700686279H1	SOYMON008	g20732	BLASTN	415	1e-50	82
3108	16	700558939H1	SOYMON001	g20732	BLASTN	472	1e-50	78
3109	16	701118441H1	SOYMON037	g169090	BLASTN	495	1e-50	80
3110	16	701046150H1	SOYMON032	g169090	BLASTN	605	1e-50	83
3111	16	700876929H1	SOYMON018	g20732	BLASTN	681	1e-50	82
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3113	16	700725046H1	SOYMON009	g2905771	BLASTN	688	1e-50	94
3114	16	700869271H1	SOYMON016	g2905771	BLASTN	688	1e-50	94

3115	16	700841465H1	SOYMON020	g19565	BLASTN	707	1e-50	83
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3117	16	700726069H1	SOYMON009	g19565	BLASTN	712	1e-50	84
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3121	16	700686557H1	SOYMON008	g169090	BLASTN	712	1e-50	85
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3123	16	700833351H1	SOYMON019	g169090	BLASTN	717	1e-50	85
3124	16	700975879H1	SOYMON009	g167043	BLASTN	379	1e-49	82
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3126	16	700750149H1	SOYMON013	g169090	BLASTN	695	1e-49	85
3127	16	700953068H1	SOYMON022	g169090	BLASTN	696	1e-49	79
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3129	16	701043647H1	SOYMON029	g19565	BLASTN	696	1e-49	82
3130	16	700985440H1	SOYMON009	g169090	BLASTN	698	1e-49	84
3131	16	701204172H1	SOYMON035	g169090	BLASTN	698	1e-49	84
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3134	16	701145287H1	SOYMON031	g19565	BLASTN	702	1e-49	83
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3136	16	700791357H1	SOYMON011	g169090	BLASTN	704	1e-49	85
3137	16	701132090H1	SOYMON038	g409574	BLASTN	704	1e-49	83
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3141	16	700953335H1	SOYMON022	g19565	BLASTN	623	1e-48	84
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3143	16	701119782H1	SOYMON037	g2905771	BLASTN	658	1e-48	92
3144	16	701108783H1	SOYMON036	g2905771	BLASTN	664	1e-48	97
3145	16	700866439H1	SOYMON016	g169090	BLASTN	682	1e-48	77
3146	16	700762316H1	SOYMON015	g169090	BLASTN	682	1e-48	83
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3148	16	701104412H1	SOYMON036	g20732	BLASTN	690	1e-48	79
3149	16	700738192H1	SOYMON012	g20732	BLASTN	690	1e-48	79
3150	16	700752442H1	SOYMON014	g20732	BLASTN	690	1e-48	79
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3153	16	701010003H2	SOYMON019	g169090	BLASTN	692	1e-48	85
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3156	16	701014245H1	SOYMON019	g19565	BLASTN	581	1e-47	84
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3163	16	700678041H1	SOYMON007	g20732	BLASTN	677	1e-47	80
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3165	16	701044525H1	SOYMON032	g169090	BLASTN	681	1e-47	90
3166	16	700998789H1	SOYMON018	g169090	BLASTN	681	1e-47	78
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3168	16	700849115H1	SOYMON021	g2905771	BLASTN	350	1e-46	95

3169	16	700660742H1	SOYMON005	g169090	BLASTN	351	1e-46	76
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3171	16	700907488H1	SOYMON022	g169090	BLASTN	467	1e-46	82
3172	16	701146736H1	SOYMON031	g19565	BLASTN	568	1e-46	81
3173	16	700872466H1	SOYMON018	g20732	BLASTN	596	1e-46	81
3174	16	701057780H1	SOYMON033	g169090	BLASTN	610	1e-46	87
3175	16	701145459H1	SOYMON031	g169090	BLASTN	660	1e-46	88
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3183	16	700750391H1	SOYMON013	g169090	BLASTN	436	1e-45	78
3184	16	700683883H1	SOYMON008	g169090	BLASTN	436	1e-45	84
3185	16	700729088H1	SOYMON009	g2078297	BLASTN	509	1e-45	85
3186	16	700903141H1	SOYMON022	g19565	BLASTN	577	1e-45	84
3187	16	701202337H1	SOYMON035	g169090	BLASTN	603	1e-45	84
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3189	16	700844326H1	SOYMON021	g19565	BLASTN	651	1e-45	86
3190	16	700741362H1	SOYMON012	g169090	BLASTN	651	1e-45	84
3191	16	700755283H1	SOYMON014	g169090	BLASTN	652	1e-45	87
3192	16	700751536H1	SOYMON014	g20732	BLASTN	652	1e-45	79
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3195	16	700680531H1	SOYMON008	g20732	BLASTN	429	1e-44	79
3196	16	701106044H1	SOYMON036	g20732	BLASTN	592	1e-44	78
3197	16	700979630H2	SOYMON009	g2905771	BLASTN	618	1e-44	97
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3202	16	700967679H1	SOYMON032	g409574	BLASTN	643	1e-44	83
3203	16	700972372H1	SOYMON005	g169090	BLASTN	644	1e-44	74
3204	16	700974446H1	SOYMON005	g19565	BLASTN	644	1e-44	85
3205	16	701146670H1	SOYMON031	g19565	BLASTN	341	1e-43	81
3206	16	701102507H1	SOYMON028	g169090	BLASTN	432	1e-43	86
3207	16	701006744H1	SOYMON019	g169090	BLASTN	453	1e-43	85
3208	16	700835690H1	SOYMON019	g169090	BLASTN	479	1e-43	84
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3211	16	700555371H1	SOYMON001	g20732	BLASTN	623	1e-43	78
3212	16	700991260H1	SOYMON011	g19565	BLASTN	623	1e-43	86
3213	16	701109867H1	SOYMON036	g20732	BLASTN</			

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3224	16	701124645H1	SOYMON037	g19565	BLASTN	505	1e-41	81
3225	16	700738430H1	SOYMON012	g169090	BLASTN	598	1e-41	83
3226	16	700980387H1	SOYMON009	g169090	BLASTN	607	1e-41	86
3227	16	701109905H1	SOYMON036	g169090	BLASTN	609	1e-41	87
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3231	16	700899494H1	SOYMON027	g169090	BLASTN	472	1e-40	88
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3235	16	701152717H1	SOYMON031	g19565	BLASTN	589	1e-40	87
3236	16	701156106H1	SOYMON031	g19565	BLASTN	590	1e-40	87
3237	16	700757283H1	SOYMON015	g169090	BLASTN	592	1e-40	75
3238	16	701153845H1	SOYMON031	g19565	BLASTN	595	1e-40	87
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3240	16	700960557H1	SOYMON022	g169090	BLASTN	280	1e-39	82
3241	16	701046409H1	SOYMON032	g409574	BLASTN	371	1e-39	76
3242	16	700648740H1	SOYMON003	g409574	BLASTN	385	1e-39	89
3243	16	700728066H1	SOYMON009	g169090	BLASTN	461	1e-39	73
3244	16	700740668H1	SOYMON012	g20732	BLASTN	575	1e-39	73
3245	16	701149559H1	SOYMON031	g19565	BLASTN	575	1e-39	86
3246	16	701124058H1	SOYMON037	g20732	BLASTN	576	1e-39	80
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3248	16	701149995H1	SOYMON031	g19565	BLASTN	583	1e-39	87
3249	16	701145383H1	SOYMON031	g19565	BLASTN	585	1e-39	84
3250	16	701064544H1	SOYMON034	g2905771	BLASTN	326	1e-38	93
3251	16	700992479H1	SOYMON011	g2078297	BLASTN	374	1e-38	80
3252	16	700739262H1	SOYMON012	g20732	BLASTN	441	1e-38	80
3253	16	700999632H1	SOYMON018	g20732	BLASTN	509	1e-38	79
3254	16	700743974H1	SOYMON012	g20732	BLASTN	562	1e-38	80
3255	16	700835707H1	SOYMON019	g169090	BLASTN	562	1e-38	86
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3257	16	701048040H1	SOYMON032	g169090	BLASTN	571	1e-38	87
3258	16	700829978H1	SOYMON019	g19565	BLASTN	573	1e-38	84
3259	16	700875006H1	SOYMON018	g20732	BLASTN	336	1e-37	91
3260	16	700830281H1	SOYMON019	g19565	BLASTN	376	1e-37	83
3261	16	700990514H1	SOYMON011	g20732	BLASTN	550	1e-37	79
3262	16	701153744H1	SOYMON031	g19565	BLASTN	557	1e-37	88
3263	16	700742768H1	SOYMON012	g169090	BLASTN	558	1e-37	90
3264	16	701149314H1	SOYMON031	g19565	BLASTN	559	1e-37	88
3265	16	700961862H1	SOYMON022	g169090	BLASTN	559	1e-37	86
3266	16	700875647H1	SOYMON018	g20732	BLASTN	560	1e-37	81
3267	16	700958014H1	SOYMON022	g19565	BLASTN	465	1e-36	81
3268	16	700854826H1	SOYMON023	g2905771	BLASTN	517	1e-36	95
3269	16	701106984H1	SOYMON036	g20732	BLASTN	539	1e-36	79
3270	16	700740352H1	SOYMON012	g20732	BLASTN	539	1e-36	79
3271	16	700903658H1	SOYMON022	g19565	BLASTN	542	1e-36	85
3272	16	700756593H1	SOYMON014	g19565	BLASTN	545	1e-36	88
3273	16	700789341H2	SOYMON011	g169090	BLASTN	546	1e-36	86
3274	16	700751528H1	SOYMON014	g20732	BLASTN	549	1e-36	78
3275	16	701046242H1	SOYMON032	g169090	BLASTN	549	1e-36	86
3276	16	700606131H2	SOYMON008	g20732	BLASTN	257	1e-35	80



3277	16	701063749H1	SOYMON034	g2905771	BLASTN	355	1e-35	97
3278	16	701156830H1	SOYMON031	g19565	BLASTN	401	1e-35	88
3279	16	701123759H1	SOYMON037	g20732	BLASTN	527	1e-35	77
3280	16	700833470H1	SOYMON019	g19565	BLASTN	533	1e-35	86
3281	16	701043561H1	SOYMON029	g169090	BLASTN	307	1e-34	81
3282	16	700685547H1	SOYMON008	g20732	BLASTN	352	1e-34	77
3283	16	701215104H1	SOYMON035	g169090	BLASTN	424	1e-34	87
3284	16	701156675H1	SOYMON031	g169090	BLASTN	439	1e-34	84
3285	16	700650109H1	SOYMON003	g169090	BLASTN	505	1e-34	83
3286	16	700996816H1	SOYMON018	g20732	BLASTN	514	1e-34	89
3287	16	700875986H1	SOYMON018	g20732	BLASTN	517	1e-34	79
3288	16	700875036H1	SOYMON018	g20732	BLASTN	520	1e-34	79
3289	16	700760859H1	SOYMON015	g169090	BLASTN	521	1e-34	85
3290	16	701203868H1	SOYMON035	g19565	BLASTN	522	1e-34	75
3291	16	700684625H1	SOYMON008	g20732	BLASTN	523	1e-34	88
3292	16	700743827H1	SOYMON012	g20550	BLASTN	277	1e-33	84
3293	16	700895366H1	SOYMON027	g20732	BLASTN	509	1e-33	71
3294	16	701155325H1	SOYMON031	g169090	BLASTN	393	1e-32	78
3295	16	700979884H2	SOYMON009	g19565	BLASTN	493	1e-32	87
3296	16	700956948H1	SOYMON022	g19565	BLASTN	497	1e-32	82
3297	16	700983542H1	SOYMON009	g19565	BLASTN	326	1e-31	76
3298	16	700750157H1	SOYMON013	g169090	BLASTN	483	1e-31	79
3299	16	700856401H1	SOYMON023	g19565	BLASTN	485	1e-31	79
3300	16	701153529H1	SOYMON031	g19565	BLASTN	487	1e-31	89
3301	16	700740510H1	SOYMON012	g169090	BLASTN	404	1e-30	84
3302	16	700742952H1	SOYMON012	g20732	BLASTN	472	1e-30	83
3303	16	700754658H1	SOYMON014	g2078297	BLASTN	385	1e-29	85
3304	16	700876748H1	SOYMON018	g20732	BLASTN	457	1e-29	74
3305	16	700673094H1	SOYMON006	g19565	BLASTN	460	1e-29	78
3306	16	700741756H1	SOYMON012	g20732	BLASTN	462	1e-29	79
3307	16	701209936H1	SOYMON035	g169090	BLASTN	464	1e-29	86
3308	16	700997818H1	SOYMON018	g20732	BLASTN	473	1e-29	78
3309	16	701150960H1	SOYMON031	g169090	BLASTN	447	1e-28	83
3310	16	700685752H1	SOYMON008	g20732	BLASTN	467	1e-28	80
3311	16	700981608H1	SOYMON009	g20732	BLASTN	467	1e-28	80
3312	16	700742082H1	SOYMON012	g20732	BLASTN	322	1e-27	83
3313	16	701146456H1	SOYMON031	g169090	BLASTN	352	1e-27	86
3314	16	700977936H1	SOYMON009	g2905771	BLASTN	423	1e-27	98
3315	16	700897772H1	SOYMON027	g20732	BLASTN	446	1e-27	83
3316	16	701064028H1	SOYMON034	g20732	BLASTN	454	1e-27	82
3317	16	701044915H1	SOYMON032	g19565	BLASTN	316	1e-26	88
3318	16	700976839H1	SOYMON009	g2905771	BLASTN	423	1e-26	98
3319	16	700830091H1	SOYMON019	g19565	BLASTN	426	1e-26	86
3320	16	700961412H1	SOYMON022	g19565	BLASTN	427	1e-26	83
3321	16	701						

3331	16	701043808H1	SOYMON032	g2078297	BLASTN	192	1e-17	76
3332	16	700563254H1	SOYMON002	g2905771	BLASTN	326	1e-17	99
3333	16	701068370H1	SOYMON034	g2905771	BLASTN	329	1e-17	95
3334	16	700840885H1	SOYMON020	g21066	BLASTX	83	1e-16	77
3335	16	701146974H1	SOYMON031	g18978	BLASTX	99	1e-16	79
3336	16	700874586H1	SOYMON018	g309671	BLASTX	171	1e-16	89
3337	16	701156431H1	SOYMON031	g309671	BLASTX	172	1e-16	68
3338	16	700731566H1	SOYMON010	g1185556	BLASTX	152	1e-15	91
3339	16	700739659H1	SOYMON012	g309671	BLASTX	161	1e-15	71
3340	16	700678096H1	SOYMON007	g169090	BLASTN	177	1e-15	81
3341	16	700957692H1	SOYMON022	g1185556	BLASTX	147	1e-14	88
3342	16	700554603H1	SOYMON001	g20732	BLASTN	195	1e-14	81
3343	16	701126861H1	SOYMON037	g19565	BLASTN	246	1e-14	85
3344	16	700679091H2	SOYMON007	g166705	BLASTN	266	1e-13	76
3345	16	700737463H1	SOYMON010	g1185556	BLASTX	130	1e-12	89
3346	16	700870957H1	SOYMON018	g309670	BLASTN	282	1e-12	80
3347	16	700651065H1	SOYMON003	g2905772	BLASTX	121	1e-11	100
3348	16	701064564H1	SOYMON034	g1185556	BLASTX	123	1e-11	89
3349	16	701000079H1	SOYMON018	g1185556	BLASTX	126	1e-11	81
3350	16	700606257H1	SOYMON008	g309671	BLASTX	136	1e-11	72
3351	16	700752373H1	SOYMON014	g19565	BLASTN	270	1e-11	92
3352	16	701130139H1	SOYMON037	g2905772	BLASTX	86	1e-10	96
3353	16	700646156H1	SOYMON012	g1185556	BLASTX	110	1e-9	92
3354	16	700743668H1	SOYMON012	g20551	BLASTX	121	1e-9	85
3355	16	700648908H1	SOYMON003	g19565	BLASTN	217	1e-9	90
3356	16	700563235H1	SOYMON002	g169090	BLASTN	220	1e-9	85
3357	1976	700961292H1	SOYMON022	g496493	BLASTN	1040	1e-77	90
3358	1976	700963585H1	SOYMON022	g496493	BLASTN	1027	1e-76	86
3359	1976	700683563H1	SOYMON008	g496493	BLASTN	1007	1e-75	86
3360	1976	700791132H1	SOYMON011	g496493	BLASTN	949	1e-70	86
3361	1976	700890465H1	SOYMON024	g496493	BLASTN	529	1e-68	87
3362	1976	700983190H1	SOYMON009	g496493	BLASTN	904	1e-66	85
3363	1976	700983490H1	SOYMON009	g496493	BLASTN	887	1e-65	81
3364	1976	700992647H1	SOYMON011	g496493	BLASTN	460	1e-56	85
3365	1976	701128429H1	SOYMON037	g496493	BLASTN	718	1e-51	86
3366	1976	700726390H1	SOYMON009	g496493	BLASTN	694	1e-49	81
3367	1976	700764629H1	SOYMON022	g496493	BLASTN	529	1e-35	83
3368	1976	700729434H1	SOYMON009	g496493	BLASTN	382	1e-34	85
3369	1976	700957553H1	SOYMON022	g496493	BLASTN	520	1e-34	91
3370	2207	700726706H1	SOYMON009	g496493	BLASTN	1080	1e-81	88
3371	2207	700553529H1	SOYMON001	g496493	BLASTN	1041	1e-77	87
3372	2207	700739431H1	SOYMON012	g496493	BLASTN	937	1e-69	85
3373	2207	700875340H1	SOYMON018	g496493	BLASTN	875	1e-64	83
3374	2207	700962678H1	SOYMON022	g496493	BLASTN	844	1e-61	83
3375	2207	701214788H1	SOYMON035	g496493	BLASTN	613	1e-42	80
3376	26781	701213755H1	SOYMON035	g1100222	BLASTN	535	1e-55	79
3377	26781	701213579H1	SOYMON035	g1100222	BLASTN	535	1e-45	79
3378	3953	701061621H1	SOYMON033	g172766	BLASTX	104	1e-12	62
3379	4979	700566452H1	SOYMON002	g166705	BLASTN	1068	1e-80	85
3380	4979	701051147H1	SOYMON032	g166705	BLASTN	993	1e-74	83
3381	4979	700851348H1	SOYMON023	g166705	BLASTN	603	1e-73	87
3382	4979	700851470H1	SOYMON023	g166705	BLASTN	978	1e-72	87
3383	4979	701014769H1	SOYMON019	g166705	BLASTN	979	1e-72	84
3384	4979	700667186H1	SOYMON006	g21065	BLASTN	964	1e-71	86

3385	4979	700734161H1	SOYMON010	g21065	BLASTN	956	1e-70	89
3386	4979	700669545H1	SOYMON006	g166705	BLASTN	783	1e-65	84
3387	4979	700895425H1	SOYMON027	g16021	BLASTN	834	1e-65	82
3388	4979	701050651H1	SOYMON032	g409574	BLASTN	892	1e-65	84
3389	4979	701014770H1	SOYMON019	g409574	BLASTN	680	1e-62	83
3390	4979	700786662H1	SOYMON011	g166709	BLASTN	445	1e-60	85
3391	4979	700974162H1	SOYMON005	g167259	BLASTN	824	1e-59	83
3392	4979	700843984H1	SOYMON021	g16021	BLASTN	801	1e-57	84
3393	4979	700893406H1	SOYMON024	g166705	BLASTN	485	1e-56	82
3394	4979	700740022H1	SOYMON012	g167259	BLASTN	654	1e-56	84
3395	4979	701051962H1	SOYMON032	g166709	BLASTN	509	1e-53	87
3396	4979	700899741H1	SOYMON027	g2078297	BLASTN	746	1e-53	84
3397	4979	700890234H1	SOYMON024	g167259	BLASTN	671	1e-47	82
3398	4979	701043720H1	SOYMON032	g166705	BLASTN	571	1e-38	87
3399	4979	700893919H1	SOYMON024	g1345501	BLASTX	179	1e-17	88
3400	535	701064754H1	SOYMON034	g496493	BLASTN	1077	1e-80	88
3401	535	700660246H1	SOYMON004	g496493	BLASTN	1022	1e-76	90
3402	535	700725553H1	SOYMON009	g496493	BLASTN	978	1e-72	86
3403	535	700906586H1	SOYMON022	g496493	BLASTN	745	1e-62	89
3404	535	700555311H1	SOYMON001	g496493	BLASTN	855	1e-62	78
3405	535	700655860H1	SOYMON004	g496493	BLASTN	792	1e-57	86
3406	535	700656931H1	SOYMON004	g496493	BLASTN	669	1e-46	86
3407	535	700684630H1	SOYMON008	g496493	BLASTN	528	1e-35	83
3408	535	700999674H1	SOYMON018	g1842115	BLASTX	183	1e-18	92
3409	667	700763868H1	SOYMON018	g496493	BLASTN	973	1e-74	83
3410	667	700789653H2	SOYMON011	g496493	BLASTN	928	1e-68	85
3411	667	700986940H1	SOYMON009	g496493	BLASTN	929	1e-68	81
3412	667	700982690H1	SOYMON009	g496493	BLASTN	845	1e-64	85
3413	667	700975608H1	SOYMON009	g496493	BLASTN	875	1e-64	82
3414	667	700874732H1	SOYMON018	g496493	BLASTN	679	1e-63	82
3415	667	700956280H1	SOYMON022	g496493	BLASTN	809	1e-61	84
3416	667	700891885H1	SOYMON024	g496493	BLASTN	816	1e-61	83
3417	667	701145577H1	SOYMON031	g496493	BLASTN	764	1e-60	84
3418	667	700975787H1	SOYMON009	g496493	BLASTN	487	1e-59	83
3419	667	700989677H1	SOYMON011	g496493	BLASTN	590	1e-58	84
3420	667	700941396H1	SOYMON024	g496493	BLASTN	781	1e-58	85
3421	667	700985895H1	SOYMON009	g496493	BLASTN	449	1e-57	82
3422	667	700788465H1	SOYMON011	g496493	BLASTN	800	1e-57	80
3423	667	700898809H1	SOYMON027	g496493	BLASTN	743	1e-55	82
3424	667	700659510H1	SOYMON004	g496493	BLASTN	712	1e-53	83
3425	667	700957466H1	SOYMON022	g496493	BLASTN	477	1e-52	82
3426	667	700957672H1	SOYMON022	g496493	BLASTN	730	1e-52	83
3427	667	700752023H1	SOYMON014	g496493	BLASTN	710	1e-50	79
3428	667	700684123H1	SOYMON008	g496493	BLASTN	657	1e-48	82
3429	667	701204216H2	SOYMON035	g496493	BLASTN	632	1e-46	77
3430	667	700684018H1	SOYMON008	g496493	BLASTN	502	1e-44	83
3431	667	700981833H1	SOYMON009	g496493	BLASTN	320	1e-43	81
3432	667	700685767H1	SOYMON008	g496493	BLASTN	566	1e-38	83
3433	667	701119840H1	SOYMON037	g496493	BLASTN	518	1e-37	82
3434	667	700739439H1	SOYMON012	g496493	BLASTN	535	1e-35	86
3435	667	701108638H1	SOYMON036	g496493	BLASTN	420	1e-26	80
3436	667	700681550H1	SOYMON008	g496493	BLASTN	247	1e-20	82
3437	667	700838733H1	SOYMON020	g474408	BLASTX	185	1e-18	80
3438	667	700874784H1	SOYMON018	g474408	BLASTX	174	1e-17	83

3439	667	700796275H1	SOYMON017	g474408	BLASTX	167	1e-16	83
3440	-GM11584	LIB3049-013-Q1-E1-F2	LIB3049	g2905771	BLASTN	257	1e-10	83
3441	-GM12588	LIB3049-035-Q1-E1-B2	LIB3049	g20728	BLASTN	448	1e-35	75
3442	-GM15977	LIB3054-003-Q1-N1-B6	LIB3054	g12158	BLASTN	601	1e-41	70
3443	-GM1666	LIB3028-009-Q1-B1-C6	LIB3028	g169090	BLASTN	647	1e-43	74
3444	-GM17526	LIB3055-013-Q1-N1-E4	LIB3055	g20728	BLASTN	249	1e-22	77
3445	-GM22093	LIB3030-004-Q1-B1-G2	LIB3030	g20551	BLASTX	102	1e-35	75
3446	-GM41500	LIB3051-097-Q1-K1-H1	LIB3051	g2905772	BLASTX	106	1e-25	44
3447	-GM4481	LIB3039-010-Q1-E1-B9	LIB3039	g169090	BLASTN	692	1e-48	65
3448	-GM5704	LIB3039-017-Q1-E1-F2	LIB3039	g166705	BLASTN	276	1e-24	75
3449	1061	LIB3028-008-Q1-B1-F6	LIB3028	g20728	BLASTN	743	1e-99	84
3450	1061	LIB3053-005-Q1-N1-D9	LIB3053	g12158	BLASTN	1302	1e-99	82
3451	1061	LIB3054-004-Q1-N1-E12	LIB3054	g20728	BLASTN	743	1e-92	84
3452	1061	LIB3053-006-Q1-N1-E5	LIB3053	g20728	BLASTN	729	1e-89	80
3453	1061	LIB3053-006-Q1-N1-C11	LIB3053	g12158	BLASTN	1096	1e-82	81
3454	1061	LIB3028-003-Q1-B1-D12	LIB3028	g20728	BLASTN	728	1e-80	86
3455	1061	LIB3040-023-Q1-E1-D10	LIB3040	g12158	BLASTN	741	1e-79	83
3456	1061	LIB3040-036-Q1-E1-A12	LIB3040	g20728	BLASTN	735	1e-71	86
3457	1061	LIB3055-006-Q1-N1-B3	LIB3055	g20728	BLASTN	667	1e-56	83
3458	1061	LIB3055-002-Q1-B1-A9	LIB3055	g20728	BLASTN	735	1e-50	86
3459	1061	LIB3040-053-Q1-E1-D5	LIB3040	g20728	BLASTN	579	1e-43	84
3460	1392	LIB3051-059-Q1-K2-D8	LIB3051	g21142	BLASTN	1165	1e-101	82
3461	1392	LIB3039-009-Q1-E1-H2	LIB3039	g19565	BLASTN	923	1e-68	80
3462	16	LIB3052-014-Q1-N1-E5	LIB3052	g20732	BLASTN	1436	1e-110	84
3463	16	LIB3055-002-Q1-B1-A6	LIB3055	g169090	BLASTN	1404	1e-108	82
3464	16	LIB3028-004-Q1-B1-C2	LIB3028	g169090	BLASTN	1399	1e-107	82
3465	16	LIB3065-011-Q1-N1-E4	LIB3065	g169090	BLASTN	1382	1e-106	83
3466	16	LIB3053-014-	LIB3053	g20732	BLASTN	727	1e-104	82

3467	16	Q1-N1-D3 LIB3051-063- Q1-K1-F4	LIB3051	g169090	BLASTN	1150	1e-103	78
3468	16	LIB3040-052- Q1-E1-B5	LIB3040	g169090	BLASTN	1247	1e-102	83
3469	16	LIB3054-006- Q1-N1-C1	LIB3054	g169090	BLASTN	1160	1e-100	83
3470	16	LIB3052-001- Q1-B1-C6	LIB3052	g169090	BLASTN	1142	1e-98	82
3471	16	LIB3055-004- Q1-N1-F6	LIB3055	g20732	BLASTN	690	1e-94	83
3472	16	LIB3051-087- Q1-K1-E1	LIB3051	g169090	BLASTN	1190	1e-94	77
3473	16	LIB3051-018- Q1-E1-H11	LIB3051	g169090	BLASTN	772	1e-91	83
3474	16	LIB3056-012- Q1-N1-H7	LIB3056	g169090	BLASTN	1132	1e-89	77
3475	16	LIB3052-014- Q1-N1-E1	LIB3052	g20732	BLASTN	1027	1e-86	79
3476	16	LIB3039-015- Q1-E1-A12	LIB3039	g169090	BLASTN	1138	1e-86	83
3477	16	LIB3039-003- Q1-E1-C4	LIB3039	g169090	BLASTN	719	1e-85	81
3478	16	LIB3040-015- Q1-E1-H5	LIB3040	g169090	BLASTN	1127	1e-85	82
3479	16	LIB3040-041- Q1-E1-A4	LIB3040	g169090	BLASTN	952	1e-84	80
3480	16	LIB3040-004- Q1-E1-E11	LIB3040	g169090	BLASTN	952	1e-84	79
3481	16	LIB3039-036- Q1-E1-D10	LIB3039	g169090	BLASTN	1110	1e-83	79
3482	16	LIB3039-030- Q1-E1-D5	LIB3039	g169090	BLASTN	1093	1e-82	79
3483	16	LIB3055-008- Q1-N1-E2	LIB3055	g169090	BLASTN	634	1e-81	84
3484	16	LIB3039-003- Q1-E1-G1	LIB3039	g169090	BLASTN	890	1e-81	78
3485	16	LIB3049-020- Q1-E1-A4	LIB3049	g169090	BLASTN	957	1e-81	78
3486	16	LIB3030-012- Q1-B1-D5	LIB3030	g169090	BLASTN	691	1e-80	74
3487	16	LIB3039-007- Q1-E1-F8	LIB3039	g169090	BLASTN	1066	1e-80	78
3488	16	LIB3056-003- Q1-N1-H12	LIB3056	g169090	BLASTN	1070	1e-80	78
3489	16	LIB3049-044- Q1-E1-H6	LIB3049	g169090	BLASTN	958	1e-79	78
3490	16	LIB3051-042- Q1-K1-D7	LIB3051	g169090	BLASTN	1047	1e-78	81
3491	16	LIB3039-005- Q1-E1-F7	LIB3039	g169090	BLASTN	957	1e-77	78
3492	16	LIB3040-028- Q1-E1-C3	LIB3040	g169090	BLASTN	974	1e-77	81
3493	16	LIB3049-014-	LIB3049	g169090	BLASTN	737	1e-76	78

		Q1-E1-A10						
3494	16	LIB3040-012-Q1-E1-G8	LIB3040	g169090	BLASTN	800	1e-76	78
3495	16	LIB3040-061-Q1-E11-F6	LIB3040	g169090	BLASTN	957	1e-76	79
3496	16	LIB3049-044-Q1-E1-G1	LIB3049	g169090	BLASTN	976	1e-75	80
3497	16	LIB3039-040-Q1-E1-A8	LIB3039	g169090	BLASTN	994	1e-74	78
3498	16	LIB3049-054-Q1-E1-G11	LIB3049	g169090	BLASTN	766	1e-73	79
3499	16	LIB3051-062-Q1-K1-B9	LIB3051	g166705	BLASTN	869	1e-73	77
3500	16	LIB3040-039-Q1-E1-A5	LIB3040	g169090	BLASTN	970	1e-72	83
3501	16	LIB3039-031-Q1-E1-E11	LIB3039	g19565	BLASTN	970	1e-72	83
3502	16	LIB3040-043-Q1-E1-G3	LIB3040	g169090	BLASTN	970	1e-72	83
3503	16	LIB3039-031-Q1-E1-A7	LIB3039	g19565	BLASTN	971	1e-72	83
3504	16	LIB3039-047-Q1-E1-B12	LIB3039	g169090	BLASTN	713	1e-71	78
3505	16	LIB3039-033-Q1-E1-D8	LIB3039	g409574	BLASTN	965	1e-71	82
3506	16	LIB3040-010-Q1-E1-A11	LIB3040	g19565	BLASTN	969	1e-71	83
3507	16	LIB3040-015-Q1-E1-G5	LIB3040	g169090	BLASTN	726	1e-70	78
3508	16	LIB3040-008-Q1-E1-G6	LIB3040	g169090	BLASTN	842	1e-70	81
3509	16	LIB3049-045-Q1-E1-H2	LIB3049	g19565	BLASTN	955	1e-70	82
3510	16	LIB3065-008-Q1-N1-B3	LIB3065	g169090	BLASTN	416	1e-69	80
3511	16	LIB3039-028-Q1-E1-D6	LIB3039	g169090	BLASTN	713	1e-69	78
3512	16	LIB3039-045-Q1-E1-D5	LIB3039	g169090	BLASTN	940	1e-69	83
3513	16	LIB3040-058-Q1-E1-G12	LIB3040	g20732	BLASTN	396	1e-68	80
3514	16	LIB3049-034-Q1-E1-F1	LIB3049	g169090	BLASTN	633	1e-67	80
3515	16	LIB3039-050-Q1-E1-C11	LIB3039	g169090	BLASTN	730	1e-67	79
3516	16	LIB3040-042-Q1-E1-E12	LIB3040	g19565	BLASTN	762	1e-67	80
3517	16	LIB3040-030-Q1-E1-E11	LIB3040	g169090	BLASTN	847	1e-67	79
3518	16	LIB3040-054-Q1-E1-E9	LIB3040	g169090	BLASTN	909	1e-67	78
3519	16	LIB3039-046-Q1-E1-H3	LIB3039	g19565	BLASTN	917	1e-67	82
3520	16	LIB3039-020-	LIB3039	g19565	BLASTN	908	1e-66	82

3521	16	Q1-E1-E1 LIB3040-036-	LIB3040	g19565	BLASTN	693	1e-63	83
3522	16	Q1-E1-F9 LIB3039-054-	LIB3039	g169090	BLASTN	633	1e-62	79
3523	16	Q1-E1-G11 LIB3040-053-	LIB3040	g169090	BLASTN	508	1e-60	77
3524	16	Q1-E1-C6 LIB3040-006-	LIB3040	g409574	BLASTN	855	1e-60	82
3525	16	Q1-E1-H9 LIB3027-011-	LIB3027	g2905771	BLASTN	754	1e-56	97
3526	16	Q1-B1-C6 LIB3039-045-	LIB3039	g169090	BLASTN	751	1e-52	73
3527	16	Q1-E1-E3 LIB3039-029-	LIB3039	g169090	BLASTN	422	1e-50	80
3528	16	Q1-E1-D8 LIB3049-022-	LIB3049	g166705	BLASTN	376	1e-46	79
3529	16	Q1-E1-G9 LIB3039-027-	LIB3039	g19565	BLASTN	417	1e-45	83
3530	16	Q1-E1-C2 LIB3040-026-	LIB3040	g169090	BLASTN	514	1e-43	69
3531	16	Q1-E1-C12 LIB3040-042-	LIB3040	g19565	BLASTN	575	1e-42	80
3532	16	Q1-E1-E1 LIB3039-003-	LIB3039	g19565	BLASTN	575	1e-42	80
3532	16	Q1-E1-A2 LIB3039-003-	LIB3039	g2905771	BLASTN	422	1e-39	87
3533	16	Q1-E1-A2 LIB3039-048-	LIB3039	g169090	BLASTN	422	1e-36	77
3534	16	Q1-E1-D6 LIB3040-018-	LIB3040	g22238	BLASTX	79	1e-34	78
3535	16	Q1-E1-G2 LIB3050-020-	LIB3050	g19565	BLASTN	549	1e-34	87
3536	16	Q1-K1-A10 LIB3051-022-	LIB3051	g19565	BLASTN	480	1e-31	85
3537	16	Q1-K1-D1 LIB3039-051-	LIB3039	g1345567	BLASTX	110	1e-28	63
3538	1976	Q1-E1-F10 LIB3053-010-	LIB3053	g496493	BLASTN	341	1e-57	83
3539	33625	Q1-N1-B4 LIB3054-008-	LIB3054	g20732	BLASTN	227	1e-11	85
3540	535	Q1-N1-D12 LIB3053-009-	LIB3053	g496493	BLASTN	808	1e-58	86
		Q1-N1-D11						

## MAIZE TRIOSE PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
3541	-700019675	700019675H1	SATMON001	g546735	BLASTX	134	1e-11	78
3542	-700073894	700073894H1	SATMON007	g609261	BLASTN	257	1e-10	84
3543	-700167260	700167260H1	SATMON013	g609261	BLASTN	644	1e-44	79
3544	-700380595	700380595H1	SATMON021	g609261	BLASTN	1121	1e-84	87
3545	-700449667	700449667H1	SATMON028	g217973	BLASTN	204	1e-18	93
3546	-700449720	700449720H2	SATMON028	g217973	BLASTN	216	1e-18	88
3547	-700570661	700570661H1	SATMON030	g168647	BLASTX	131	1e-11	88
3548	-700616770	700616770H1	SATMON033	g407525	BLASTX	149	1e-13	83
3549	-701170944	701170944H1	SATMONN05	g217921	BLASTX	188	1e-20	53

3550	11337	700337974H1	SATMON020	g256119	BLASTN	535	1e-61	78
3551	11337	700027829H1	SATMON003	g256119	BLASTN	726	1e-51	80
3552	126	700050046H1	SATMON003	g1785947	BLASTN	440	1e-26	92
3553	282	700077320H1	SATMON007	g217973	BLASTN	666	1e-108	97
3554	282	700104541H1	SATMON010	g217973	BLASTN	631	1e-106	97
3555	282	700047476H1	SATMON003	g217973	BLASTN	648	1e-105	97
3556	282	700211559H1	SATMON016	g217973	BLASTN	525	1e-104	97
3557	282	700073553H1	SATMON007	g217973	BLASTN	981	1e-103	98
3558	282	700613011H1	SATMON033	g217973	BLASTN	552	1e-102	98
3559	282	700352119H1	SATMON023	g217973	BLASTN	666	1e-101	97
3560	282	700088148H1	SATMON011	g217973	BLASTN	666	1e-100	98
3561	282	700351626H1	SATMON023	g217973	BLASTN	401	1e-99	98
3562	282	700240096H1	SATMON010	g217973	BLASTN	666	1e-98	97
3563	282	700083660H1	SATMON011	g217973	BLASTN	666	1e-97	99
3564	282	700208721H1	SATMON016	g217973	BLASTN	497	1e-96	98
3565	282	700203144H1	SATMON003	g217973	BLASTN	511	1e-96	96
3566	282	700430425H1	SATMONN01	g217973	BLASTN	666	1e-96	98
3567	282	700206091H1	SATMON003	g217973	BLASTN	497	1e-94	97
3568	282	700077017H1	SATMON007	g217973	BLASTN	614	1e-93	93
3569	282	700618792H1	SATMON034	g217973	BLASTN	546	1e-92	96
3570	282	700572532H1	SATMON030	g407524	BLASTN	1212	1e-92	84
3571	282	700106512H1	SATMON010	g217973	BLASTN	632	1e-91	97
3572	282	700195031H1	SATMON014	g217973	BLASTN	471	1e-90	97
3573	282	700168131H1	SATMON013	g217973	BLASTN	497	1e-89	98
3574	282	700197039H1	SATMON014	g217973	BLASTN	546	1e-89	98
3575	282	700572688H1	SATMON030	g169820	BLASTN	1114	1e-89	85
3576	282	700021313H1	SATMON001	g217973	BLASTN	913	1e-87	97
3577	282	700452417H1	SATMON028	g217973	BLASTN	425	1e-86	95
3578	282	700346119H1	SATMON021	g217973	BLASTN	444	1e-86	96
3579	282	700082359H1	SATMON011	g217973	BLASTN	542	1e-86	93
3580	282	700240042H1	SATMON010	g217973	BLASTN	596	1e-86	97
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3582	282	700615185H1	SATMON033	g217973	BLASTN	430	1e-84	98
3583	282	700196125H1	SATMON014	g217973	BLASTN	581	1e-84	100
3584	282	700243429H1	SATMON010	g217973	BLASTN	632	1e-84	97
3585	282	700474112H1	SATMON025	g217973	BLASTN	570	1e-83	98
3586	282	700572282H1	SATMON030	g407524	BLASTN	838	1e-83	82
3587	282	700622238H1	SATMON034	g169820	BLASTN	917	1e-80	86
3588	282	700095609H1	SATMON008	g169820	BLASTN	1067	1e-80	82
3589	282	700218886H1	SATMON011	g217973	BLASTN	551	1e-79	93
3590	282	700018688H1	SATMON001	g217973	BLASTN	1066	1e-79	99
3591	282	700049775H1	SATMON003	g217973	BLASTN	362	1e-78	91
3592	282	700575972H1	SATMON030	g169820	BLASTN	894	1e-78	79
3593	282	700215519H1	SATMON016	g217973	BLASTN	497	1e-76	97
3594	282	700161120H1	SATMON012	g217973	BLASTN	622	1e-76	98
3595	282	700581760H1	SATMON031	g217973	BLASTN	533	1e-75	90
3596	282	700104672H1	SATMON010	g169820	BLASTN	1012	1e-75	83
3597	282	700346053H1	SATMON021	g169820	BLASTN	1012	1e-75	83
3598	282	701166592H1	SATMONN04	g217973	BLASTN	661	1e-74	95
3599	282	700968667H1	SATMONN04	g217973	BLASTN	497	1e-73	92
3600	282	700205627H1	SATMON003	g217973	BLASTN	666	1e-73	99
3601	282	700029005H1	SATMON003	g169820	BLASTN	979	1e-72	85
3602	282	700476479H1	SATMON025	g169820	BLASTN	554	1e-71	84
3603	282	700050148H1	SATMON003	g169820	BLASTN	608	1e-70	83



3604	282	700259846H1	SATMON017	g217973	BLASTN	283	1e-69	94
3605	282	700344093H1	SATMON021	g169820	BLASTN	934	1e-69	83
3606	282	700082327H1	SATMON011	g169820	BLASTN	943	1e-69	85
3607	282	700020156H1	SATMON001	g217973	BLASTN	420	1e-68	99
3608	282	700577714H1	SATMON031	g169820	BLASTN	928	1e-68	85
3609	282	700104904H1	SATMON010	g169820	BLASTN	913	1e-67	84
3610	282	700104685H1	SATMON010	g169820	BLASTN	897	1e-66	84
3611	282	700053463H1	SATMON009	g169820	BLASTN	907	1e-66	85
3612	282	700171639H1	SATMON013	g217973	BLASTN	401	1e-65	98
3613	282	700574233H1	SATMON030	g169820	BLASTN	651	1e-65	83
3614	282	700262653H1	SATMON017	g169820	BLASTN	877	1e-64	84
3615	282	700456738H1	SATMON029	g169820	BLASTN	877	1e-64	84
3616	282	700611806H1	SATMON022	g169820	BLASTN	877	1e-64	83
3617	282	700381177H1	SATMON023	g169820	BLASTN	884	1e-64	84
3618	282	700103347H1	SATMON010	g169820	BLASTN	861	1e-63	84
3619	282	700103605H1	SATMON010	g169820	BLASTN	868	1e-63	84
3620	282	700578536H1	SATMON031	g169820	BLASTN	856	1e-62	84
3621	282	700258606H1	SATMON017	g169820	BLASTN	807	1e-61	83
3622	282	700335703H1	SATMON019	g217973	BLASTN	376	1e-60	90
3623	282	700351044H1	SATMON023	g169820	BLASTN	471	1e-59	83
3624	282	700346364H1	SATMON021	g169820	BLASTN	813	1e-59	85
3625	282	700619037H1	SATMON034	g169820	BLASTN	814	1e-59	84
3626	282	700465160H1	SATMON025	g169820	BLASTN	751	1e-57	84
3627	282	700235687H1	SATMON010	g169820	BLASTN	791	1e-57	82
3628	282	700105645H1	SATMON010	g169820	BLASTN	793	1e-57	83
3629	282	700082237H1	SATMON011	g169820	BLASTN	793	1e-57	84
3630	282	700261906H1	SATMON017	g169820	BLASTN	796	1e-57	83
3631	282	700456154H1	SATMON029	g169820	BLASTN	799	1e-57	84
3632	282	700047696H1	SATMON003	g169820	BLASTN	561	1e-56	83
3633	282	700449905H1	SATMON028	g169820	BLASTN	788	1e-56	84
3634	282	700336106H1	SATMON019	g217973	BLASTN	325	1e-55	92
3635	282	700381867H1	SATMON023	g2529386	BLASTN	422	1e-55	97
3636	282	700051335H1	SATMON003	g169820	BLASTN	608	1e-55	83
3637	282	700050988H1	SATMON003	g169820	BLASTN	768	1e-55	86
3638	282	700029471H1	SATMON003	g169820	BLASTN	772	1e-55	84
3639	282	700106806H1	SATMON010	g169820	BLASTN	773	1e-55	84
3640	282	700071749H1	SATMON007	g217973	BLASTN	362	1e-54	85
3641	282	700207607H1	SATMON016	g217973	BLASTN	362	1e-54	85
3642	282	700573465H2	SATMON030	g169820	BLASTN	753	1e-54	86
3643	282	700220908H1	SATMON011	g169820	BLASTN	758	1e-54	84
3644	282	700467719H1	SATMON025	g169820	BLASTN	761	1e-54	85
3645	282	700456018H1	SATMON029	g169820	BLASTN	764	1e-54	81
3646	282	700453767H1	SATMON029	g217973	BLASTN	296	1e-52	94
3647	282	700026118H1	SATMON003	g217973	BLASTN	341	1e-52	93
3648	282	700026760H1	SATMON003	g217973	BLASTN	421	1e-52	99
3649	282	700029525H1	SATMON003	g169820	BLASTN	738	1e-52	85
3650	282	700457972H1	SATMON029	g169820	BLASTN	723	1e-51	85
3651	282	700455866H1	SATMON029	g169820	BLASTN	726	1e-51	84
3652	282	700165290H1	SATMON013	g169820	BLASTN	726	1e-51	84
3653	282	700351190H1	SATMON023	g169820	BLASTN	672	1e-50	81
3654	282	700154095H1	SATMON007	g169820	BLASTN	696	1e-49	84
3655	282	700450438H1	SATMON028	g217973	BLASTN	430	1e-48	99
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3658	282	700575506H1	SATMON030	g169820	BLASTN	680	1e-47	83
3659	282	700161966H1	SATMON012	g217973	BLASTN	335	1e-46	98
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3662	282	701164924H1	SATMONN04	g169820	BLASTN	397	1e-44	84
3663	282	700346896H1	SATMON021	g169820	BLASTN	496	1e-42	84
3664	282	700210157H1	SATMON016	g169820	BLASTN	617	1e-42	84
3665	282	700383103H1	SATMON024	g169820	BLASTN	531	1e-41	84
3666	282	701158829H1	SATMONN04	g407524	BLASTN	549	1e-40	80
3667	282	700619883H1	SATMON034	g217973	BLASTN	325	1e-38	99
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3670	282	700334861H1	SATMON019	g169820	BLASTN	484	1e-31	82
3671	282	700355663H1	SATMON024	g217973	BLASTN	213	1e-30	88
3672	282	700074764H1	SATMON007	g546734	BLASTN	387	1e-27	84
3673	282	700621934H1	SATMON034	g217973	BLASTN	430	1e-26	100
3674	282	700802084H1	SATMON036	g217973	BLASTN	270	1e-24	98
3675	3039	700620444H1	SATMON034	g1785947	BLASTN	473	1e-56	75
3676	3039	700356205H1	SATMON024	g1785947	BLASTN	332	1e-32	72
3677	3039	700215549H1	SATMON016	g414549	BLASTN	443	1e-26	72
3678	3039	700620318H1	SATMON034	g556171	BLASTX	214	1e-25	79
3679	3039	700028742H1	SATMON003	g556171	BLASTX	156	1e-20	86
3680	3039	700150060H1	SATMON007	g556171	BLASTX	181	1e-17	89
3681	3039	700448477H1	SATMON027	g556171	BLASTX	137	1e-12	85
3682	3039	700336489H1	SATMON019	g556171	BLASTX	126	1e-10	81
3683	3414	700099709H1	SATMON009	g609261	BLASTN	600	1e-49	84
3684	3414	700075837H1	SATMON007	g609261	BLASTN	494	1e-41	84
3685	3414	700045678H1	SATMON004	g609261	BLASTN	340	1e-29	73
3686	3414	700097852H1	SATMON009	g609261	BLASTN	436	1e-27	84
3687	3414	700053342H1	SATMON009	g609261	BLASTN	346	1e-25	73
3688	3414	700041954H1	SATMON004	g609261	BLASTN	340	1e-24	82
3689	3414	700217471H1	SATMON016	g609261	BLASTN	265	1e-21	71
3690	3414	700264437H1	SATMON017	g609261	BLASTN	231	1e-17	69
3691	3414	700218371H1	SATMON016	g609261	BLASTN	156	1e-10	68
3692	5593	700381686H1	SATMON023	g609261	BLASTN	534	1e-44	89
3693	5593	700356082H1	SATMON024	g609261	BLASTN	246	1e-24	90
3694	5593	700622077H1	SATMON034	g609261	BLASTN	292	1e-20	86
3695	5593	700470822H1	SATMON025	g609262	BLASTX	134	1e-11	79
3696	6525	700083139H1	SATMON011	g256119	BLASTN	880	1e-64	76
3697	6525	700205474H1	SATMON003	g169820	BLASTN	849	1e-62	77
3698	6991	700336856H1	SATMON019	g609261	BLASTN	1131	1e-85	85
3699	6991	700042717H1	SATMON004	g609261	BLASTN	1028	1e-76	85
3700	6991	700379491H1	SATMON020	g609261	BLASTN	995	1e-74	81
3701	6991	700156635H1	SATMON012	g609261				

3711	-L30623620	Q1-K1-C9 LIB3062-034-	LIB3062	g609261	BLASTN	599	1e-39	74
3712	-L361705	Q1-K1-A8 LIB36-021-	LIB36	g609261	BLASTN	266	1e-14	80
3713	23992	Q1-E1-E7 LIB3062-056-	LIB3062	g1200507	BLASTX	285	1e-64	61
3714	282	Q1-K1-F9 LIB3067-047-	LIB3067	g217973	BLASTN	1076	1e-164	96
3715	282	Q1-K1-H2 LIB3067-055-	LIB3067	g217973	BLASTN	1076	1e-133	93
3716	282	Q1-K1-G8 LIB3067-059-	LIB3067	g169820	BLASTN	1401	1e-115	84
3717	282	Q1-K1-D10 LIB3067-027-	LIB3067	g407524	BLASTN	995	1e-113	83
3718	282	Q1-K1-B10 LIB189-032-	LIB189	g217973	BLASTN	629	1e-111	93
3719	282	Q1-E1-H2 LIB3059-023-	LIB3059	g407524	BLASTN	1436	1e-111	83
3720	282	Q1-K1-A7 LIB3069-016-	LIB3069	g169820	BLASTN	1301	1e-107	81
3721	282	Q1-K1-D9 LIB143-006-	LIB143	g169820	BLASTN	1373	1e-105	84
3722	282	Q1-E1-A8 LIB3068-054-	LIB3068	g169820	BLASTN	1327	1e-102	82
3723	282	Q1-K1-C11 LIB3067-034-	LIB3067	g407524	BLASTN	1321	1e-101	83
3724	282	Q1-K1-B7 LIB143-031-	LIB143	g169820	BLASTN	1311	1e-100	84
3725	282	Q1-E1-E5 LIB3069-055-	LIB3069	g169820	BLASTN	1046	1e-97	75
3726	282	Q1-K1-H12 LIB3061-027-	LIB3061	g169820	BLASTN	936	1e-96	83
3727	282	Q1-K1-A8 LIB3078-008-	LIB3078	g169820	BLASTN	1210	1e-92	82
3728	282	Q1-K1-E5 LIB3066-027-	LIB3066	g407524	BLASTN	1196	1e-91	82
3729	282	Q1-K1-E1 LIB3067-032-	LIB3067	g169820	BLASTN	1122	1e-84	84
3730	282	Q1-K1-E5 LIB3078-029-	LIB3078	g169820	BLASTN	827	1e-83	82
3731	282	Q1-K1-F7 LIB3061-006-	LIB3061	g169820	BLASTN	1091	1e-82	78
3732	282	Q1-K1-B7 LIB143-048-	LIB143	g169820	BLASTN	644	1e-74	75
3733	282	Q1-E1-F8 LIB3078-033-	LIB3078	g169820	BLASTN	584	1e-73	79
3734	282	Q1-K1-B10 LIB3069-046-	LIB3069	g169820	BLASTN	819	1e-59	79
3735	282	Q1-K1-C4 LIB3061-049-	LIB3061	g169820	BLASTN	587	1e-47	80
3736	282	Q1-K1-H2 LIB143-029-	LIB143	g169820	BLASTN	679	1e-47	84
3737	282	Q1-E1-G4 LIB84-027-	LIB84	g169820	BLASTN	613	1e-46	78

3738	282	Q1-E1-E5 LIB3062-001- Q1-K2-F7	LIB3062	g169820	BLASTN	507	1e-33	80
3739	282	LIB3066-014- Q1-K1-H11	LIB3066	g169820	BLASTN	385	1e-25	76
3740	29645	LIB3069-014- Q1-K1-C11	LIB3069	g168647	BLASTX	131	1e-27	34
3741	29645	LIB3069-013- Q1-K1-C11	LIB3069	g168647	BLASTX	124	1e-24	33
3742	3039	LIB3062-045- Q1-K1-F6	LIB3062	g1785947	BLASTN	1119	1e-84	72
3743	5593	LIB3067-045- Q1-K1-E5	LIB3067	g609261	BLASTN	702	1e-58	75
3744	6991	LIB3059-026- Q1-K1-G9	LIB3059	g609261	BLASTN	1493	1e-115	84
3745	6991	LIB3078-049- Q1-K1-E4	LIB3078	g609261	BLASTN	747	1e-55	83
3746	7384	LIB3062-034- Q1-K1-A4	LIB3062	g609261	BLASTN	1351	1e-107	85

#### SOYBEAN TRIOSE PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
3747	-700743237	700743237H1	SOYMON012	g407525	BLASTX	173	1e-17	91
3748	-700977730	700977730H1	SOYMON009	g602589	BLASTN	373	1e-20	71
3749	-701056176	701056176H1	SOYMON032	g806311	BLASTN	752	1e-53	74
3750	-701110172	701110172H1	SOYMON036	g806311	BLASTN	801	1e-57	78
3751	10244	700995141H1	SOYMON011	g806311	BLASTN	470	1e-30	87
3752	10244	701124548H1	SOYMON037	g806311	BLASTN	490	1e-30	88
3753	10244	700739771H1	SOYMON012	g806311	BLASTN	329	1e-16	77
3754	10244	700999820H1	SOYMON018	g806312	BLASTX	147	1e-13	84
3755	10244	701119858H1	SOYMON037	g806312	BLASTX	118	1e-9	72
3756	10535	700988684H1	SOYMON009	g806311	BLASTN	905	1e-66	79
3757	10535	700902425H1	SOYMON027	g806311	BLASTN	872	1e-63	80
3758	1357	701069004H1	SOYMON034	g806311	BLASTN	832	1e-60	81
3759	1357	701151554H1	SOYMON031	g806311	BLASTN	568	1e-38	82
3760	1357	700659936H1	SOYMON004	g806311	BLASTN	545	1e-36	79
3761	16	700680927H1	SOYMON008	g256119	BLASTN	1020	1e-81	78
3762	16	700656871H1	SOYMON004	g256119	BLASTN	903	1e-66	81
3763	16	701124364H1	SOYMON037	g256119	BLASTN	872	1e-64	80
3764	16	701134707H2	SOYMON038	g256119	BLASTN	874	1e-64	81
3765	16	700673750H1	SOYMON007	g256119	BLASTN	781	1e-60	81
3766	16	701123269H1	SOYMON037	g602589	BLASTN	819	1e-59	78
3767	16	701004846H1	SOYMON019	g256119	BLASTN	801	1e-58	80
3768	16	700993362H1	SOYMON011	g256119	BLASTN	808	1e-58	80
3769	16	701005445H1	SOYMON019	g256119	BLASTN	630	1e-56	78
3770	16	701134327H1	SOYMON038	g602589	BLASTN	782	1e-56	79
3771	16	701148169H1	SOYMON031	g602589	BLASTN	574	1e-51	76
3772	16	701153410H1	SOYMON031	g602589	BLASTN	451	1e-50	80
3773	16	700830168H1	SOYMON019	g256119	BLASTN	705	1e-50	77
3774	16	701120627H1	SOYMON037	g602589	BLASTN	715	1e-50	78
3775	16	700975358H1	SOYMON009	g602589	BLASTN	628	1e-49	77
3776	16	700755979H1	SOYMON014	g602589	BLASTN	697	1e-49	79
3777	16	701131374H1	SOYMON038	g602589	BLASTN	703	1e-49	79
3778	16	700994166H1	SOYMON011	g602589	BLASTN	513	1e-47	77

3779	16	701138038H1	SOYMON038	g602589	BLASTN	672	1e-47	77
3780	16	700974248H1	SOYMON005	g602589	BLASTN	658	1e-46	77
3781	16	700655832H1	SOYMON004	g602589	BLASTN	664	1e-46	78
3782	16	700758320H1	SOYMON015	g602589	BLASTN	409	1e-45	80
3783	16	701064709H1	SOYMON034	g602589	BLASTN	477	1e-45	78
3784	16	701138504H1	SOYMON038	g602589	BLASTN	591	1e-45	76
3785	16	700980284H1	SOYMON009	g602589	BLASTN	652	1e-45	79
3786	16	701133585H2	SOYMON038	g602589	BLASTN	634	1e-44	78
3787	16	700674706H1	SOYMON007	g602589	BLASTN	634	1e-44	78
3788	16	700964927H1	SOYMON022	g602589	BLASTN	639	1e-44	78
3789	16	700830923H1	SOYMON019	g602589	BLASTN	626	1e-43	76
3790	16	700662845H1	SOYMON005	g602589	BLASTN	617	1e-42	76
3791	16	701133824H1	SOYMON038	g602589	BLASTN	619	1e-42	78
3792	16	700848913H1	SOYMON021	g602589	BLASTN	603	1e-41	77
3793	16	701005984H1	SOYMON019	g602589	BLASTN	604	1e-41	78
3794	16	701140769H1	SOYMON038	g602589	BLASTN	605	1e-41	76
3795	16	700753357H1	SOYMON014	g602589	BLASTN	328	1e-40	78
3796	16	701056336H1	SOYMON032	g602589	BLASTN	344	1e-40	77
3797	16	700895411H1	SOYMON027	g602589	BLASTN	593	1e-40	78
3798	16	701060188H1	SOYMON033	g602589	BLASTN	277	1e-39	80
3799	16	700739461H1	SOYMON012	g602589	BLASTN	573	1e-39	77
3800	16	700941104H1	SOYMON024	g602589	BLASTN	579	1e-39	79
3801	16	700732960H1	SOYMON010	g602589	BLASTN	581	1e-39	78
3802	16	700686476H1	SOYMON008	g602589	BLASTN	583	1e-39	79
3803	16	701054231H1	SOYMON032	g602589	BLASTN	583	1e-39	77
3804	16	700671690H1	SOYMON006	g602589	BLASTN	566	1e-38	77
3805	16	700941174H1	SOYMON024	g602589	BLASTN	569	1e-38	78
3806	16	701125091H1	SOYMON037	g256119	BLASTN	358	1e-37	74
3807	16	700989827H1	SOYMON011	g602589	BLASTN	555	1e-37	78
3808	16	700835006H1	SOYMON019	g602589	BLASTN	555	1e-37	75
3809	16	700834847H1	SOYMON019	g602589	BLASTN	559	1e-37	78
3810	16	700953411H1	SOYMON022	g602589	BLASTN	314	1e-36	80
3811	16	700869222H1	SOYMON016	g602589	BLASTN	541	1e-36	78
3812	16	700850633H1	SOYMON023	g602589	BLASTN	544	1e-36	78
3813	16	700890283H1	SOYMON024	g602589	BLASTN	310	1e-35	80
3814	16	700727079H1	SOYMON009	g414549	BLASTN	358	1e-35	73
3815	16	700892544H1	SOYMON024	g602589	BLASTN	486	1e-35	78
3816	16	700869230H1	SOYMON016	g602589	BLASTN	528	1e-35	78
3817	16	700993034H1	SOYMON011	g602589	BLASTN	518	1e-34	75
3818	16	700975553H1	SOYMON009	g414549	BLASTN	524	1e-34	79
3819	16	700651326H1	SOYMON003	g602589	BLASTN	356	1e-33	80
3820	16	701215308H1	SOYMON035	g414549	BLASTN	450	1e-33	75
3821	16	700654480H1	SOYMON004	g414549	BLASTN	511	1e-33	80
3822	16	701045128H1	SOYMON032	g414549	BLASTN	512	1e-33	78
3823	16	701060759H1	SOYMON033					

3833	16	701058218H1	SOYMON033	g602589	BLASTN	495	1e-31	78
3834	16	700975165H1	SOYMON009	g414549	BLASTN	466	1e-30	80
3835	16	701100165H1	SOYMON028	g602589	BLASTN	485	1e-30	79
3836	16	701150241H1	SOYMON031	g602589	BLASTN	455	1e-29	79
3837	16	701098308H1	SOYMON028	g414549	BLASTN	460	1e-29	79
3838	16	701150440H1	SOYMON031	g602589	BLASTN	462	1e-29	78
3839	16	700685125H1	SOYMON008	g414549	BLASTN	471	1e-29	81
3840	16	701061565H1	SOYMON033	g414549	BLASTN	471	1e-29	81
3841	16	700991418H1	SOYMON011	g602589	BLASTN	394	1e-28	68
3842	16	701156156H1	SOYMON031	g602589	BLASTN	456	1e-28	78
3843	16	701007231H2	SOYMON019	g602589	BLASTN	461	1e-28	79
3844	16	700829667H1	SOYMON019	g414549	BLASTN	333	1e-27	73
3845	16	701156033H1	SOYMON031	g602589	BLASTN	432	1e-27	78
3846	16	701014293H1	SOYMON019	g414549	BLASTN	446	1e-27	77
3847	16	700945665H1	SOYMON024	g414549	BLASTN	450	1e-27	81
3848	16	701152138H1	SOYMON031	g414549	BLASTN	450	1e-27	81
3849	16	701001407H1	SOYMON018	g169820	BLASTN	219	1e-26	72
3850	16	700983185H1	SOYMON009	g414549	BLASTN	435	1e-26	72
3851	16	700752364H1	SOYMON014	g414549	BLASTN	441	1e-26	76
3852	16	700992409H1	SOYMON011	g414549	BLASTN	427	1e-25	75
3853	16	701109396H1	SOYMON036	g414549	BLASTN	420	1e-24	76
3854	16	701151402H1	SOYMON031	g556171	BLASTX	151	1e-23	85
3855	16	701149617H1	SOYMON031	g556171	BLASTX	158	1e-23	86
3856	16	700747310H1	SOYMON013	g414549	BLASTN	406	1e-23	73
3857	16	701139569H1	SOYMON038	g556171	BLASTX	191	1e-22	84
3858	16	701213275H1	SOYMON035	g602589	BLASTN	255	1e-22	80
3859	16	701157185H1	SOYMON031	g556171	BLASTX	197	1e-20	90
3860	16	700655520H1	SOYMON004	g556171	BLASTX	166	1e-19	86
3861	16	701010779H1	SOYMON019	g556171	BLASTX	173	1e-19	64
3862	16	701044104H1	SOYMON032	g556171	BLASTX	188	1e-19	89
3863	16	700867605H1	SOYMON016	g556171	BLASTX	160	1e-17	70
3864	16	701125521H1	SOYMON037	g414550	BLASTX	166	1e-16	81
3865	16	701058593H1	SOYMON033	g168647	BLASTX	169	1e-16	94
3866	16	701070286H1	SOYMON034	g168647	BLASTX	164	1e-15	91
3867	16	700649007H1	SOYMON003	g414550	BLASTX	152	1e-14	88
3868	16	700876790H1	SOYMON018	g168647	BLASTX	154	1e-14	93
3869	16	700877219H1	SOYMON018	g168647	BLASTX	154	1e-14	93
3870	16	700877212H1	SOYMON018	g168647	BLASTX	154	1e-14	93
3871	16	700760847H1	SOYMON015	g556171	BLASTX	138	1e-13	86
3872	16	700893711H1	SOYMON024	g168647	BLASTX	140	1e-13	82
3873	16	700557532H1	SOYMON001	g256120	BLASTX	115	1e-12	88
3874	16	700793802H1	SOYMON017	g556171	BLASTX	138	1e-12	93
3875	16	700659725H1	SOYMON004	g556171	BLASTX	144	1e-12	47
3876	16	701044545H1	SOYMON032	g556171	BLASTX	144	1e-12	92
3877	16	701037485H1	SOYMON029					

3887	31	700670393H1	SOYMON006	g806312	BLASTX	167	1e-16	78
3888	31	700559280H1	SOYMON001	g609262	BLASTX	164	1e-15	69
3889	31	700793048H1	SOYMON017	g806312	BLASTX	97	1e-12	60
3890	31	700993683H1	SOYMON011	g806312	BLASTX	103	1e-11	60
3891	31	700663233H1	SOYMON005	g806312	BLASTX	130	1e-11	56
3892	31	700908079H1	SOYMON022	g806312	BLASTX	103	1e-10	60
3893	31	701043447H1	SOYMON029	g609262	BLASTX	126	1e-10	84
3894	31	700740188H1	SOYMON012	g806312	BLASTX	103	1e-8	60
3895	7466	700742922H1	SOYMON012	g806311	BLASTN	435	1e-27	76
3896	7466	700606255H1	SOYMON008	g806312	BLASTX	117	1e-17	80
3897	16	LIB3053-005-Q1-N1-F9	LIB3053	g602589	BLASTN	1000	1e-74	77
3898	16	LIB3039-035-Q1-E1-C5	LIB3039	g602589	BLASTN	979	1e-72	78
3899	16	LIB3039-031-Q1-E1-A8	LIB3039	g256119	BLASTN	911	1e-71	80
3900	16	LIB3030-003-Q1-B1-C9	LIB3030	g602589	BLASTN	949	1e-70	78
3901	16	LIB3039-023-Q1-E1-H12	LIB3039	g602589	BLASTN	913	1e-67	78
3902	16	LIB3039-047-Q1-E1-D8	LIB3039	g602589	BLASTN	566	1e-65	75
3903	16	LIB3039-052-Q1-E1-D6	LIB3039	g602589	BLASTN	890	1e-65	77
3904	16	LIB3039-051-Q1-E1-A1	LIB3039	g602589	BLASTN	855	1e-62	78
3905	16	LIB3049-009-Q1-E1-G5	LIB3049	g602589	BLASTN	783	1e-56	78
3906	16	LIB3039-009-Q1-E1-C1	LIB3039	g602589	BLASTN	805	1e-56	78
3907	16	LIB3055-006-Q1-N1-H3	LIB3055	g256119	BLASTN	481	1e-54	78
3908	16	LIB3055-013-Q1-N1-C3	LIB3055	g256119	BLASTN	769	1e-54	79
3909	16	LIB3049-034-Q1-E1-A2	LIB3049	g602589	BLASTN	626	1e-51	76
3910	16	LIB3049-022-Q1-E1-F9	LIB3049	g602589	BLASTN	519	1e-43	78
3911	16	LIB3049-030-Q1-E1-C7	LIB3049	g602589	BLASTN	572	1e-38	77
3912	16	LIB3040-035-Q1-E1-C5	LIB3040	g556171	BLASTX	175	1e-33	82
3913	16	LIB3040-005-Q1-E1-H8	LIB3040	g169820	BLASTN	324	1e-33	76
3914	16	LIB3028-025-Q1-B1-D1	LIB3028	g602589	BLASTN	464	1e-33	78
3915	16	LIB3039-022-Q1-E1-D5	LIB3039	g602589	BLASTN	357	1e-32	73
3916	16	LIB3052-001-Q1-B1-C5	LIB3052	g414549	BLASTN	327	1e-29	73
3917	28599	LIB3039-047-Q1-E1-D9	LIB3039	g806311	BLASTN	1183	1e-94	81
3918	28599	LIB3039-048-Q1-E1-D12	LIB3039	g806311	BLASTN	1007	1e-92	81





3962	38	Q1-K1-F10 LIB3061-025-	LIB3061	g22144	BLASTN	895	1e-133	94
3963	38	Q1-K1-C9 LIB3059-020- Q1-K1-H3	LIB3059	g22144	BLASTN	745	1e-53	98

#### SOYBEAN ALDOLASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
3964	-700565253	700565253H1	SOYMON002	g3021337	BLASTN	352	1e-39	76
3965	-700865276	700865276H1	SOYMON016	g3021337	BLASTN	629	1e-43	76
3966	-700873022	700873022H1	SOYMON018	g3696	BLASTX	211	1e-26	70
3967	-700943855	700943855H1	SOYMON024	g20204	BLASTX	202	1e-20	86
3968	-700974965	700974965H1	SOYMON005	g3021337	BLASTN	259	1e-10	84
3969	-701039850	701039850H1	SOYMON029	g22632	BLASTN	408	1e-23	76
3970	-701206840	701206840H1	SOYMON035	g3021338	BLASTX	151	1e-13	83
3971	11792	700654881H1	SOYMON004	g20204	BLASTX	150	1e-13	76
3972	11792	700746016H1	SOYMON013	g3021337	BLASTN	284	1e-12	67
3973	12314	701037190H1	SOYMON029	g3021337	BLASTN	634	1e-44	78
3974	12314	701042664H1	SOYMON029	g3021338	BLASTX	197	1e-20	66
3975	16	700651596H1	SOYMON003	g3021337	BLASTN	1101	1e-83	86
3976	16	700750439H1	SOYMON013	g3021337	BLASTN	1078	1e-81	86
3977	16	700649475H1	SOYMON003	g3021337	BLASTN	1082	1e-81	84
3978	16	700652995H1	SOYMON003	g3021337	BLASTN	1084	1e-81	82
3979	16	700981967H1	SOYMON009	g3021337	BLASTN	1071	1e-80	85
3980	16	700863243H1	SOYMON023	g3021337	BLASTN	1044	1e-78	86
3981	16	700558625H1	SOYMON001	g3021337	BLASTN	1041	1e-77	84
3982	16	700564806H1	SOYMON002	g3021337	BLASTN	1021	1e-76	80
3983	16	700746368H1	SOYMON013	g3021337	BLASTN	897	1e-75	86
3984	16	700960290H1	SOYMON022	g3021337	BLASTN	1009	1e-75	87
3985	16	701055132H1	SOYMON032	g3021337	BLASTN	1011	1e-75	86
3986	16	701056109H1	SOYMON032	g3021337	BLASTN	1012	1e-75	84
3987	16	701119884H1	SOYMON037	g3021337	BLASTN	1014	1e-75	87
3988	16	700898149H1	SOYMON027	g3021337	BLASTN	1015	1e-75	86
3989	16	700661436H1	SOYMON005	g3021337	BLASTN	596	1e-74	83
3990	16	701042223H1	SOYMON029	g3021337	BLASTN	997	1e-74	84
3991	16	700676004H1	SOYMON007	g3021337	BLASTN	984	1e-73	85
3992	16	700747718H1	SOYMON013	g3021337	BLASTN	988	1e-73	87
3993	16	700751133H1	SOYMON014	g3021337	BLASTN	989	1e-73	86
3994	16	701215247H1	SOYMON035	g3021337	BLASTN	989	1e-73	84
3995	16	700652484H1	SOYMON003	g3021337	BLASTN	910	1e-72	85
3996	16	700981960H1	SOYMON009	g3021337	BLASTN	970	1e-72	87
3997	16	700869785H1	SOYMON016	g3021337	BLASTN	970	1e-72	87
3998	16	700969335H1	SOYMON005	g3021337	BLASTN	972	1e-72	82
3999	16	700854174H1	SOYMON023	g3021337	BLASTN	965	1e-71	84
4000	16	700761638H1	SOYMON015	g3021337	BLASTN	966	1e-71	86
4001	16	701005716H1	SOYMON019	g3021337	BLASTN	967	1e-71	83
4002	16	700984860H1	SOYMON009	g3021337	BLASTN	967	1e-71	84
4003	16	700941053H1	SOYMON024	g3021337	BLASTN	968	1e-71	86
4004	16	700561358H1	SOYMON002	g3021337	BLASTN	968	1e-71	82
4005	16	700564906H1	SOYMON002	g3021337	BLASTN	562	1e-70	82
4006	16	700833951H1	SOYMON019	g3021337	BLASTN	954	1e-70	88
4007	16	701117626H1	SOYMON037	g3021337	BLASTN	957	1e-70	85
4008	16	700729103H1	SOYMON009	g3021337	BLASTN	535	1e-69	86

4009	16	700670615H1	SOYMON006	g3021337	BLASTN	936	1e-69	83
4010	16	701053635H1	SOYMON032	g3021337	BLASTN	941	1e-69	84
4011	16	700982280H1	SOYMON009	g3021337	BLASTN	923	1e-68	82
4012	16	701119874H1	SOYMON037	g3021337	BLASTN	925	1e-68	88
4013	16	700758937H1	SOYMON015	g3021337	BLASTN	926	1e-68	87
4014	16	701214027H1	SOYMON035	g3021337	BLASTN	928	1e-68	82
4015	16	700972858H1	SOYMON005	g3021337	BLASTN	929	1e-68	84
4016	16	701099780H1	SOYMON028	g3021337	BLASTN	930	1e-68	85
4017	16	700829560H1	SOYMON019	g3021337	BLASTN	932	1e-68	85
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4019	16	701142336H1	SOYMON038	g3021337	BLASTN	750	1e-67	81
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4021	16	700969222H1	SOYMON005	g3021337	BLASTN	913	1e-67	84
4022	16	700670956H1	SOYMON006	g3021337	BLASTN	920	1e-67	84
4023	16	701013771H1	SOYMON019	g3021337	BLASTN	921	1e-67	81
4024	16	700895725H1	SOYMON027	g3021337	BLASTN	921	1e-67	84
4025	16	701055481H1	SOYMON032	g3021337	BLASTN	654	1e-66	80
4026	16	700753940H1	SOYMON014	g3021337	BLASTN	899	1e-66	84
4027	16	700974141H1	SOYMON005	g3021337	BLASTN	900	1e-66	81
4028	16	700562408H1	SOYMON002	g3021337	BLASTN	902	1e-66	82
4029	16	700685292H1	SOYMON008	g3021337	BLASTN	903	1e-66	83
4030	16	700985157H1	SOYMON009	g3021337	BLASTN	907	1e-66	82
4031	16	701038194H1	SOYMON029	g3021337	BLASTN	907	1e-66	82
4032	16	700986633H1	SOYMON009	g3021337	BLASTN	908	1e-66	83
4033	16	700564282H1	SOYMON002	g3021337	BLASTN	517	1e-65	83
4034	16	700733754H1	SOYMON010	g3021337	BLASTN	680	1e-65	84
4035	16	700988179H1	SOYMON009	g3021337	BLASTN	887	1e-65	82
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4037	16	701206717H1	SOYMON035	g3021337	BLASTN	888	1e-65	81
4038	16	700968494H1	SOYMON036	g3021337	BLASTN	889	1e-65	86
4039	16	700677674H1	SOYMON007	g3021337	BLASTN	894	1e-65	83
4040	16	700906271H1	SOYMON022	g3021337	BLASTN	894	1e-65	82
4041	16	700970391H1	SOYMON005	g3021337	BLASTN	896	1e-65	83
4042	16	700753641H1	SOYMON014	g3021337	BLASTN	897	1e-65	82
4043	16	700646593H1	SOYMON014	g3021337	BLASTN	468	1e-64	80
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4045	16	700746523H1	SOYMON013	g3021337	BLASTN	744	1e-64	83
4046	16	700899019H1	SOYMON027	g3021337	BLASTN	875	1e-64	83
4047	16	701127167H1	SOYMON037	g3021337	BLASTN	876	1e-64	84
4048	16	701131053H1	SOYMON038	g3021337	BLASTN	879	1e-64	84
4049	16	701055811H1	SOYMON032	g3021337	BLASTN	881	1e-64	85
4050	16	700670980H1	SOYMON006	g3021337	BLASTN	881	1e-64	83
4051	16	700900103H1	SOYMON027	g3021337	BLASTN	882	1e-64	83
4052	16	700975609H1	SOYMON009	g3021337	BLASTN	882	1e-64	84
4053	16	701102865H1	SOYMON028	g3021337	BLASTN	883	1e-64	85
4054	16	701145255H1	SOYMON031	g3021337	BLASTN	509	1e-63	80
4055	16	701210875H1	SOYMON035	g3021337	BLASTN	616	1e-63	84
4056	16	700646664H1	SOYMON014	g3021337	BLASTN	862	1e-63	85
4057	16	700897337H1	SOYMON027	g3021337	BLASTN	865	1e-63	86
4058	16	700736783H1	SOYMON010	g3021337	BLASTN	867	1e-63	83
4059	16	701059586H1	SOYMON033	g3021337	BLASTN	869	1e-63	81
4060	16	701127063H1	SOYMON037	g3021337	BLASTN	412	1e-62	84
4061	16	700556614H1	SOYMON001	g3021337	BLASTN	475	1e-62	86
4062	16	700672681H1	SOYMON006	g3021337	BLASTN	818	1e-62	82

4063	16	700727057H1	SOYMON009	g3021337	BLASTN	850	1e-62	82
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4065	16	700561860H1	SOYMON002	g3021337	BLASTN	854	1e-62	81
4066	16	700677460H1	SOYMON007	g3021337	BLASTN	855	1e-62	83
4067	16	700749578H1	SOYMON013	g3021337	BLASTN	856	1e-62	81
4068	16	700971671H1	SOYMON005	g3021337	BLASTN	856	1e-62	81
4069	16	700672288H1	SOYMON006	g3021337	BLASTN	860	1e-62	81
4070	16	701068481H1	SOYMON034	g3021337	BLASTN	861	1e-62	81
4071	16	700729913H1	SOYMON009	g3021337	BLASTN	661	1e-61	79
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4073	16	700830902H1	SOYMON019	g3021337	BLASTN	814	1e-61	83
4074	16	700895304H1	SOYMON027	g3021337	BLASTN	840	1e-61	82
4075	16	700605676H2	SOYMON005	g3021337	BLASTN	842	1e-61	84
4076	16	700677453H1	SOYMON007	g3021337	BLASTN	843	1e-61	83
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4079	16	701004956H1	SOYMON019	g3021337	BLASTN	849	1e-61	82
4080	16	700958213H1	SOYMON022	g3021337	BLASTN	849	1e-61	82
4081	16	701129305H1	SOYMON037	g3021337	BLASTN	659	1e-60	85
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4083	16	700832047H1	SOYMON019	g3021337	BLASTN	738	1e-60	83
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4085	16	700659491H1	SOYMON004	g3021337	BLASTN	829	1e-60	83
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4087	16	700758028H1	SOYMON015	g3021337	BLASTN	829	1e-60	81
4088	16	701060964H1	SOYMON033	g3021337	BLASTN	833	1e-60	81
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4092	16	700967633H1	SOYMON032	g3021337	BLASTN	530	1e-59	81
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4096	16	701048203H1	SOYMON032	g3021337	BLASTN	816	1e-59	81
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4101	16	700834462H1	SOYMON019	g3021337	BLASTN	823	1e-59	81
4102	16	700562478H1	SOYMON002	g3021337	BLASTN	487	1e-58	84
4103	16	700788114H1	SOYMON011	g3021337	BLASTN	751	1e-58	83
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4105	16	700837427H1	SOYMON020	g3021337	BLASTN	805	1e-58	86
4106	16	700753668H1	SOYMON014	g3021337	BLASTN	806	1e-58	85

4117	16	700727996H1	SOYMON009	g3021337	BLASTN	468	1e-56	79
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4121	16	700866138H1	SOYMON016	g3021337	BLASTN	641	1e-55	86
4122	16	700904813H1	SOYMON022	g3021337	BLASTN	699	1e-55	85
4123	16	700669945H1	SOYMON006	g3021337	BLASTN	773	1e-55	86
4124	16	700894146H1	SOYMON024	g3021337	BLASTN	773	1e-55	86
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4136	16	701100040H2	SOYMON028	g3021337	BLASTN	602	1e-53	85
4137	16	700895328H1	SOYMON027	g3021337	BLASTN	742	1e-53	83
4138	16	701141083H1	SOYMON038	g3021337	BLASTN	751	1e-53	85
4139	16	700829878H1	SOYMON019	g3021337	BLASTN	417	1e-52	86
4140	16	700671825H1	SOYMON006	g3021337	BLASTN	431	1e-52	79
4141	16	700755240H1	SOYMON014	g3021337	BLASTN	731	1e-52	88
4142	16	701011659H1	SOYMON019	g3021337	BLASTN	734	1e-52	86
4143	16	701011547H1	SOYMON019	g3021337	BLASTN	381	1e-51	84
4144	16	700835614H1	SOYMON019	g3021337	BLASTN	437	1e-51	80
4145	16	700671849H1	SOYMON006	g3021337	BLASTN	471	1e-51	87
4146	16	700734822H1	SOYMON010	g3021337	BLASTN	486	1e-51	79
4147	16	700830223H1	SOYMON019	g3021337	BLASTN	622	1e-51	84
4148	16	700659970H1	SOYMON004	g3021337	BLASTN	722	1e-51	82
4149	16	701101779H1	SOYMON028	g3021337	BLASTN	728	1e-51	86
4150	16	700852553H1	SOYMON023	g3021337	BLASTN	490	1e-50	88
4151	16	700853857H1	SOYMON023	g3021337	BLASTN	711	1e-50	88
4152	16	700980358H1	SOYMON009	g3021337	BLASTN	712	1e-50	85
4153	16	700672182H1	SOYMON006	g3021337	BLASTN	714	1e-50	89
4154	16	700748455H1	SOYMON013	g3021337	BLASTN	396	1e-49	85
4155	16	700657257H1	SOYMON004	g3021337	BLASTN	694	1e-49	75
4156	16	700729301H1	SOYMON009	g3021337	BLASTN	702	1e-49	80
4157	16	700726175H1	SOYMON009	g3021337	BLASTN	704	1e-49	80
4158	16	700966844H1	SOYMON028	g3021337	BLASTN	414	1e-47	81
4159	16	700960965H1	SOYMON022	g3021337	BLASTN	452	1e-47	85
4160	16	700678326H1	SOYMON007	g3021337	BLASTN	480	1e-47	83

4171	16	700666809H1	SOYMON005	g3021337	BLASTN	621	1e-42	82
4172	16	701098073H1	SOYMON028	g3021337	BLASTN	285	1e-41	83
4173	16	700669492H1	SOYMON006	g3021337	BLASTN	504	1e-39	83
4174	16	700975340H1	SOYMON009	g3021337	BLASTN	574	1e-39	81
4175	16	700753528H1	SOYMON014	g3021337	BLASTN	576	1e-39	81
4176	16	700665923H1	SOYMON005	g3021337	BLASTN	373	1e-35	84
4177	16	701038320H1	SOYMON029	g3021337	BLASTN	518	1e-34	84
4178	16	700755605H1	SOYMON014	g3021337	BLASTN	431	1e-33	81
4179	16	700890349H1	SOYMON024	g3021337	BLASTN	511	1e-33	88
4180	16	700669817H1	SOYMON006	g3021337	BLASTN	363	1e-31	87
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4182	16	700562959H1	SOYMON002	g3021337	BLASTN	482	1e-30	81
4183	16	700852454H1	SOYMON023	g3021337	BLASTN	446	1e-28	77
4184	16	701121443H1	SOYMON037	g3021337	BLASTN	418	1e-24	84
4185	16	701118247H1	SOYMON037	g3021337	BLASTN	280	1e-18	85
4186	16	700665401H1	SOYMON005	g927505	BLASTX	172	1e-16	94
4187	16	700750038H1	SOYMON013	g3021338	BLASTX	162	1e-15	84
4188	16	700665414H1	SOYMON005	g3021337	BLASTN	273	1e-13	88
4189	16	700889072H1	SOYMON024	g3021338	BLASTX	136	1e-11	83
4190	16	700727964H1	SOYMON009	g927505	BLASTX	137	1e-11	86
4191	16	700680648H1	SOYMON008	g3021337	BLASTN	226	1e-10	73
4192	16	701044547H1	SOYMON032	g927505	BLASTX	91	1e-9	76
4193	16	700649174H1	SOYMON003	g3021338	BLASTX	126	1e-9	83
4194	16531	701120682H1	SOYMON037	g3021337	BLASTN	716	1e-50	77
4195	1701	700993909H1	SOYMON011	g22633	BLASTX	112	1e-31	78
4196	1701	700955490H1	SOYMON022	g22633	BLASTX	176	1e-25	70
4197	1701	700682081H1	SOYMON008	g22633	BLASTX	147	1e-20	68
4198	1701	700988843H1	SOYMON011	g22633	BLASTX	90	1e-14	67
4199	1701	700740531H1	SOYMON012	g22633	BLASTX	92	1e-12	64
4200	1701	700790059H2	SOYMON011	g22633	BLASTX	92	1e-12	67
4201	1701	700872670H1	SOYMON018	g169037	BLASTX	144	1e-12	90
4202	1701	700990591H1	SOYMON011	g22632	BLASTN	199	1e-11	68
4203	1701	700743120H1	SOYMON012	g22633	BLASTX	92	1e-9	68
4204	1701	700994931H1	SOYMON011	g22633	BLASTX	92	1e-8	64
4205	1938	700738074H1	SOYMON012	g927507	BLASTX	134	1e-11	90
4206	239	701126904H1	SOYMON037	g169037	BLASTX	231	1e-24	81
4207	239	700668532H1	SOYMON006	g169037	BLASTX	202	1e-20	83
4208	239	700666028H1	SOYMON005	g218155	BLASTX	186	1e-18	78
4209	239	701009915H2	SOYMON019	g169037	BLASTX	180	1e-17	84
4210	239	700943660H1	SOYMON024	g169037	BLASTX	180	1e-17	84
4211	239	701100047H2	SOYMON028	g169037	BLASTX	160	1e-15	84
4212	239	700794458H1	SOYMON017	g22633	BLASTX	131	1e-10	58
4213	239	700738441H1	SOYMON012	g169037	BLASTX	118	1e-8	78
4214	3425	700984050H1	SOYMON009	g3021337	BLASTN	874	1e-64	80
4215								

4225	3425	700898446H1	SOYMON027	g3021337	BLASTN	686	1e-48	83
4226	3425	701006432H1	SOYMON019	g3021337	BLASTN	688	1e-48	83
4227	3425	701041476H1	SOYMON029	g3021337	BLASTN	693	1e-48	81
4228	3425	700568335H1	SOYMON002	g3021337	BLASTN	678	1e-47	82
4229	3425	701046312H1	SOYMON032	g3021337	BLASTN	650	1e-45	85
4230	3425	701050171H1	SOYMON032	g3021337	BLASTN	650	1e-45	85
4231	3425	700685063H1	SOYMON008	g3021337	BLASTN	643	1e-44	83
4232	3425	701010250H2	SOYMON019	g3021337	BLASTN	542	1e-36	86
4233	3425	700665454H1	SOYMON005	g3021337	BLASTN	520	1e-34	80
4234	3425	701043888H1	SOYMON032	g3021337	BLASTN	495	1e-32	85
4235	3425	700726806H1	SOYMON009	g3021337	BLASTN	213	1e-23	76
4236	491	700997879H1	SOYMON018	g22632	BLASTN	789	1e-56	77
4237	491	700646208H1	SOYMON012	g22632	BLASTN	733	1e-52	76
4238	491	700559796H1	SOYMON001	g22632	BLASTN	715	1e-50	76
4239	491	700789784H1	SOYMON011	g22632	BLASTN	664	1e-46	76
4240	491	700683122H1	SOYMON008	g22632	BLASTN	485	1e-41	86
4241	491	701105914H1	SOYMON036	g22632	BLASTN	504	1e-41	73
4242	491	700558789H1	SOYMON001	g22632	BLASTN	607	1e-41	74
4243	491	700873051H1	SOYMON018	g22632	BLASTN	608	1e-41	75
4244	491	700684010H1	SOYMON008	g22632	BLASTN	597	1e-40	75
4245	491	700786096H2	SOYMON011	g22632	BLASTN	576	1e-39	75
4246	491	700731865H1	SOYMON010	g22632	BLASTN	582	1e-39	75
4247	491	701108111H1	SOYMON036	g22632	BLASTN	467	1e-38	75
4248	491	700740887H1	SOYMON012	g22632	BLASTN	567	1e-38	74
4249	491	700559579H1	SOYMON001	g22632	BLASTN	572	1e-38	75
4250	491	700996104H1	SOYMON018	g22632	BLASTN	476	1e-37	76
4251	491	700682145H1	SOYMON008	g22632	BLASTN	542	1e-36	74
4252	491	700737263H1	SOYMON010	g22632	BLASTN	526	1e-35	74
4253	491	700547963H1	SOYMON001	g22632	BLASTN	527	1e-35	73
4254	491	700686296H1	SOYMON008	g22632	BLASTN	527	1e-35	73
4255	491	700646072H1	SOYMON011	g22632	BLASTN	537	1e-35	74
4256	491	701106662H1	SOYMON036	g22632	BLASTN	514	1e-34	74
4257	491	700684335H1	SOYMON008	g22632	BLASTN	516	1e-34	74
4258	491	701000609H1	SOYMON018	g22632	BLASTN	520	1e-34	74
4259	491	700685658H1	SOYMON008	g22632	BLASTN	520	1e-34	74
4260	491	700875532H1	SOYMON018	g22632	BLASTN	521	1e-34	73
4261	491	700685813H1	SOYMON008	g22632	BLASTN	502	1e-33	74
4262	491	700872948H1	SOYMON018	g22632	BLASTN	502	1e-33	74
4263	491	700730264H1	SOYMON009	g22632	BLASTN	502	1e-33	74
4264	491	701104554H1	SOYMON036	g22632	BLASTN	503	1e-33	74
4265	491	700960601H1	SOYMON022	g22632	BLASTN	503	1e-33	74
4266	491	700876633H1	SOYMON018	g22632	BLASTN	503	1e-33	74
4267	491	700739662H1	SOYMON012	g22632	BLASTN	504	1e-33	72
4268	491	700685904H1	SOYMON008	g22632	BLASTN	505	1e-33	72
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4280	491	700685976H1	SOYMON008	g22632	BLASTN	476	1e-30	74
4281	491	700739629H1	SOYMON012	g22632	BLASTN	486	1e-30	70
4282	491	700989163H1	SOYMON011	g22632	BLASTN	468	1e-29	72
4283	491	701000555H1	SOYMON018	g22632	BLASTN	477	1e-29	72
4284	491	700872702H1	SOYMON018	g22632	BLASTN	436	1e-28	72
4285	491	701000781H1	SOYMON018	g22632	BLASTN	460	1e-28	73
4286	491	700682760H1	SOYMON008	g22632	BLASTN	463	1e-28	72
4287	491	700740390H1	SOYMON012	g22632	BLASTN	440	1e-27	73
4288	491	700685346H1	SOYMON008	g22632	BLASTN	451	1e-27	72
4289	491	700557272H1	SOYMON001	g22632	BLASTN	250	1e-26	78
4290	491	700953343H1	SOYMON022	g22632	BLASTN	349	1e-26	74
4291	491	700741960H1	SOYMON012	g22632	BLASTN	430	1e-26	73
4292	491	700680247H2	SOYMON008	g22632	BLASTN	425	1e-25	67
4293	491	700680002H2	SOYMON008	g22632	BLASTN	241	1e-24	72
4294	491	700684827H1	SOYMON008	g22632	BLASTN	379	1e-24	74
4295	491	700956353H1	SOYMON022	g22632	BLASTN	410	1e-24	72
4296	491	700787513H1	SOYMON011	g22632	BLASTN	235	1e-22	72
4297	491	700725070H1	SOYMON009	g22632	BLASTN	241	1e-22	71
4298	491	700741111H1	SOYMON012	g22632	BLASTN	304	1e-22	73
4299	491	700738230H1	SOYMON012	g22632	BLASTN	241	1e-21	72
4300	491	700985308H1	SOYMON009	g22632	BLASTN	241	1e-21	80
4301	491	700991396H1	SOYMON011	g22632	BLASTN	350	1e-21	72
4302	491	700741276H1	SOYMON012	g22632	BLASTN	379	1e-21	71
4303	491	700740223H1	SOYMON012	g22632	BLASTN	241	1e-20	72
4304	491	700738808H1	SOYMON012	g22632	BLASTN	241	1e-20	72
4305	491	700997995H1	SOYMON018	g22632	BLASTN	241	1e-19	81
4306	491	700989713H1	SOYMON011	g22632	BLASTN	241	1e-19	73
4307	491	700875139H1	SOYMON018	g22632	BLASTN	241	1e-19	71
4308	491	700958366H1	SOYMON022	g22632	BLASTN	241	1e-18	71
4309	491	700683887H1	SOYMON008	g22632	BLASTN	344	1e-18	70
4310	491	700740788H1	SOYMON012	g22632	BLASTN	339	1e-17	70
4311	491	700743058H1	SOYMON012	g22632	BLASTN	205	1e-16	81
4312	491	700996423H1	SOYMON018	g22632	BLASTN	234	1e-16	80
4313	491	700686075H1	SOYMON008	g22632	BLASTN	241	1e-16	71
4314	491	700738811H1	SOYMON012	g22632	BLASTN	193	1e-15	72
4315	491	700998312H1	SOYMON018	g22632	BLASTN	234	1e-15	73
4316	491	700681825H1	SOYMON008	g22632	BLASTN	241	1e-15	81
4317	491	701109105H1	SOYMON036	g22632	BLASTN	290	1e-14	69
4318	491	701203741H2	SOYMON035	g22632	BLASTN	230	1e-13	78
4319	491	700740785H1	SOYMON012	g22632	BLASTN	287	1e-13	68
4320	491	700738486H1	SOYMON012	g22632	BLASTN	295	1e-13	64
4321	491	700739078H1	SOYMON012	g22632	BLASTN	178	1e-12	73
4322	491	701002287H1	SOYMON018	g22632	BLASTN	255	1e-12	74
4323	491	700742470H1	SOYMON012					

4333	491	700875039H1	SOYMON018	g22632	BLASTN	241	1e-9	72
4334	491	700743495H1	SOYMON012	g22632	BLASTN	241	1e-9	76
4335	491	700743995H1	SOYMON012	g22632	BLASTN	241	1e-9	76
4336	491	700743301H1	SOYMON012	g22632	BLASTN	241	1e-9	76
4337	491	700742515H1	SOYMON012	g22632	BLASTN	241	1e-9	76
4338	491	701001445H1	SOYMON018	g169037	BLASTX	115	1e-8	92
4339	491	700554881H1	SOYMON001	g169037	BLASTX	116	1e-8	94
4340	491	700954194H1	SOYMON022	g169037	BLASTX	116	1e-8	94
4341	491	700996869H1	SOYMON018	g22632	BLASTN	230	1e-8	76
4342	491	700897820H1	SOYMON027	g22632	BLASTN	234	1e-8	74
4343	491	700742574H1	SOYMON012	g22632	BLASTN	234	1e-8	74
4344	491	700684738H1	SOYMON008	g22632	BLASTN	235	1e-8	75
4345	7368	700739343H1	SOYMON012	g927507	BLASTX	164	1e-15	88
4346	-GM32379	LIB3051-015-Q1-E1-B12	LIB3051	g3021337	BLASTN	260	1e-28	77
4347	-GM8265	LIB3039-048-Q1-E1-F11	LIB3039	g3021337	BLASTN	481	1e-29	65
4348	16	LIB3027-010-Q1-B1-B7	LIB3027	g3021337	BLASTN	1393	1e-107	82
4349	16	LIB3039-049-Q1-E1-B8	LIB3039	g3021337	BLASTN	1297	1e-99	83
4350	16	LIB3051-061-Q1-K1-E11	LIB3051	g3021337	BLASTN	1303	1e-99	84
4351	16	LIB3056-009-Q1-N1-A10	LIB3056	g3021337	BLASTN	1126	1e-96	84
4352	16	LIB3051-025-Q1-K1-E11	LIB3051	g3021337	BLASTN	1262	1e-96	83
4353	16	LIB3056-014-Q1-N1-E1	LIB3056	g3021337	BLASTN	1077	1e-94	81
4354	16	LIB3055-005-Q1-N1-A8	LIB3055	g3021337	BLASTN	1227	1e-93	84
4355	16	LIB3040-045-Q1-E1-A4	LIB3040	g3021337	BLASTN	1211	1e-92	83
4356	16	LIB3028-010-Q1-B1-G9	LIB3028	g3021337	BLASTN	1215	1e-92	83
4357	16	LIB3056-010-Q1-N1-G8	LIB3056	g3021337	BLASTN	1217	1e-92	84
4358	16	LIB3039-029-Q1-E1-A6	LIB3039	g3021337	BLASTN	1128	1e-85	85
4359	16	LIB3051-014-Q1-E1-D2	LIB3051	g3021337	BLASTN	716	1e-80	83
4360	16	LIB3030-010-Q1-B1-D7	LIB3030	g3021337	BLASTN	1052	1e-78	83
4361	16	LIB3051-094-Q1-K1-A9	LIB3051	g3021337	BLASTN	778	1e-74	83
4362	16	LIB3028-030-Q1-B1-C9	LIB3028	g3021337	BLASTN	953	1e-70	85
4363	16	LIB3052-004-Q1-N1-D8	LIB3052	g3021337	BLASTN	868	1e-63	82
4364	16	LIB3065-014-Q1-N1-A3	LIB3065	g3021337	BLASTN	540	1e-61	79
4365	16	LIB3050-019-Q1-K1-H1	LIB3050	g168420	BLASTX	223	1e-40	63
4366	16	LIB3051-062-	LIB3051	g3021337	BLASTN	541	1e-38	79



4367	3425	Q1-K1-B5 LIB3051-067-	LIB3051	g3021337	BLASTN	1082	1e-81	78
4368	3425	Q1-K1-E7 LIB3050-006-	LIB3050	g3021337	BLASTN	752	1e-57	75
4369	491	Q1-E1-G7 LIB3028-011-	LIB3028	g22632	BLASTN	911	1e-67	75
4370	491	Q1-B1-B9 LIB3028-011-	LIB3028	g22632	BLASTN	886	1e-65	77
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#### MAIZE FRUCTOSE-1,6-BISPHOSPHATASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4371	-700262935	700262935H1	SATMON017	g3041775	BLASTX	184	1e-18	94
4372	-700432173	700432173H1	SATMONN01	g1790679	BLASTX	123	1e-16	56
4373	-700455709	700455709H1	SATMON029	g3041776	BLASTN	597	1e-40	85
4374	-700573083	700573083H1	SATMON030	g3041775	BLASTX	69	1e-10	64
4375	-701158577	701158577H1	SATMONN04	g895908	BLASTN	200	1e-10	84
4376	12846	700101851H1	SATMON009	g3041776	BLASTN	1312	1e-100	91
4377	12846	700101541H1	SATMON009	g3041776	BLASTN	1252	1e-95	90
4378	12846	700581510H1	SATMON031	g3041776	BLASTN	872	1e-82	90
4379	15627	700046054H1	SATMON004	g21736	BLASTN	1213	1e-92	91
4380	15627	700421605H1	SATMONN01	g3041776	BLASTN	664	1e-77	90
4381	15627	700445495H1	SATMON027	g21736	BLASTN	1004	1e-74	84
4382	15627	700042188H1	SATMON004	g3041776	BLASTN	875	1e-64	88
4383	16870	700100752H1	SATMON009	g3041776	BLASTN	257	1e-33	75
4384	16870	700044805H1	SATMON004	g3041776	BLASTN	194	1e-14	76
4385	16870	700099217H1	SATMON009	g21736	BLASTN	246	1e-9	59
4386	25562	701166271H1	SATMONN04	g895908	BLASTN	352	1e-43	91
4387	25562	701163676H1	SATMONN04	g895908	BLASTN	299	1e-37	91
4388	32637	700097620H1	SATMON009	g895908	BLASTN	1380	1e-106	92
4389	32637	700580175H1	SATMON031	g895908	BLASTN	930	1e-68	89
4390	5480	700098780H1	SATMON009	g895908	BLASTN	1103	1e-90	95
4391	5480	700043335H1	SATMON004	g895908	BLASTN	1026	1e-76	93
4392	5480	700043111H1	SATMON004	g895908	BLASTN	879	1e-64	97
4393	5480	700442189H1	SATMON026	g3041774	BLASTN	536	1e-54	93
4394	5480	700208394H1	SATMON016	g895908	BLASTN	520	1e-43	92
4395	5480	700045530H1	SATMON004	g895908	BLASTN	613	1e-42	97
4396	5480	700098393H1	SATMON009	g895908	BLASTN	308	1e-16	88
4397	8243	700264654H1	SATMON017	g3041774	BLASTN	942	1e-69	84
4398	8243	700479624H1	SATMON034	g3041774	BLASTN	902	1e-66	82
4399	8243	700448974H1	SATMON028	g3041774	BLASTN	876	1e-64	84
4400	8666	700100948H1	SATMON009	g895908	BLASTN	1327	1e-101	92
4401	8666	700212964H1	SATMON016	g895908	BLASTN	1189	1e-90	91
4402	8666	700578027H1	SATMON031	g895908	BLASTN	1076	1e-80	91
4403	-L1485381	LIB148-057-	LIB148	g440591	BLASTX	80	1e-30	63
		Q1-E1-E6						
4404	-L30662838	LIB3066-032-	LIB3066	g895908	BLASTN	640	1e-58	86
		Q1-K1-F11						
4405	-L30662839	LIB3066-035-	LIB3066	g3041774	BLASTN	215	1e-15	77
		Q1-K1-F11						
4406	-L362913	LIB36-013-	LIB36	g3041776	BLASTN	937	1e-69	88
		Q1-E1-D10						
4407	-L831319	LIB83-003-	LIB83	g895908	BLASTN	341	1e-58	86



4443	1894	700554755H1	SOYMON001	g515746	BLASTN	767	1e-98	99
4444	1894	701000504H1	SOYMON018	g515746	BLASTN	626	1e-95	98
4445	1894	700738115H1	SOYMON012	g515746	BLASTN	1230	1e-93	100
4446	1894	700992933H1	SOYMON011	g515746	BLASTN	1074	1e-91	98
4447	1894	701107444H1	SOYMON036	g515746	BLASTN	1201	1e-91	99
4448	1894	700852823H1	SOYMON023	g515746	BLASTN	1041	1e-90	98
4449	1894	700733478H1	SOYMON010	g515746	BLASTN	1150	1e-90	97
4450	1894	701105185H1	SOYMON036	g515746	BLASTN	641	1e-87	89
4451	1894	700737830H1	SOYMON012	g515746	BLASTN	1060	1e-87	100
4452	1894	700685110H1	SOYMON008	g515746	BLASTN	597	1e-86	90
4453	1894	700968307H1	SOYMON036	g515746	BLASTN	1113	1e-84	97
4454	1894	700653014H1	SOYMON003	g515746	BLASTN	587	1e-82	90
4455	1894	700555504H1	SOYMON001	g515746	BLASTN	626	1e-81	88
4456	1894	700751540H1	SOYMON014	g515746	BLASTN	585	1e-77	91
4457	1894	700901976H1	SOYMON027	g515746	BLASTN	505	1e-73	87
4458	1894	700986496H1	SOYMON009	g515746	BLASTN	559	1e-73	90
4459	1894	700751580H1	SOYMON014	g515746	BLASTN	569	1e-72	89
4460	1894	700751532H1	SOYMON014	g515746	BLASTN	571	1e-72	90
4461	1894	700990937H1	SOYMON011	g515746	BLASTN	544	1e-71	88
4462	1894	700740789H1	SOYMON012	g515746	BLASTN	630	1e-69	100
4463	1894	700743994H1	SOYMON012	g515746	BLASTN	945	1e-69	100
4464	1894	700754374H1	SOYMON014	g515746	BLASTN	460	1e-62	91
4465	1894	701001295H1	SOYMON018	g515746	BLASTN	541	1e-62	97
4466	1894	701155952H1	SOYMON031	g515746	BLASTN	568	1e-51	83
4467	1894	700872212H1	SOYMON018	g515746	BLASTN	670	1e-47	100
4468	1894	700682196H1	SOYMON008	g515746	BLASTN	609	1e-41	98
4469	1894	700738779H1	SOYMON012	g515746	BLASTN	252	1e-16	82
4470	26568	700844816H1	SOYMON021	g21244	BLASTN	649	1e-45	78
4471	27512	701128049H1	SOYMON037	g440591	BLASTX	185	1e-18	87
4472	27512	701152064H1	SOYMON031	g895908	BLASTN	243	1e-9	77
4473	7128	700649626H1	SOYMON003	g166955	BLASTN	326	1e-25	79
4474	7128	700649846H1	SOYMON003	g440591	BLASTX	125	1e-15	81
4475	10348	LIB3030-010-	LIB3030	g21244	BLASTN	476	1e-28	76

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4476	-700097383	700097383H1	SATMON009	g664902	BLASTN	1029	1e-76	80
4477	-701159054	701159054H1	SATMONN04	g2529342	BLASTX	214	1e-27	79
4478	-701184582	701184582H1	SATMONN06	g1658321	BLASTN	745	1e-53	74
4479	1244	700553205H1	SATMON022	g1658321	BLASTN	816	1e-59	75
4480	1244	700473792H1	SATMON025	g1658321	BLASTN	826	1e-59	75
4481	1244	700405168H1	SATMON028	g1658321	BLASTN	805	1e-58	75
4482	1244	700089307H1	SATMON011	g1658321	BLASTN	743	1e-53	74
4483	1244	700355533H1	SATMON024	g1658321	BLASTN	589	1e-51	76
4484	1244	700085136H1	SATMON011	g1658321	BLASTN	690	1e-48	76
4485	1244	700382850H1	SATMON024	g664900	BLASTN	537	1e-47	72
4486	1244	700454437H1	SATMON029	g1658321	BLASTN	655	1e-45	75
4487	1244	700150022H1	SATMON007	g1658321	BLASTN	606	1e-41	76
4488	1244	700212701H1	SATMON016	g1658321	BLASTN	507	1e-40	74
4489	1244	700438654H1	SATMON026	g2529342	BLASTX	160	1e-24	89
4490	1244	700458530H1	SATMON029	g2529342	BLASTX	177	1e-20	87
4491	2946	700262031H1	SATMON017	g1658321	BLASTN	467	1e-30	74

4492	3403	700075930H1	SATMON007	g664900	BLASTN	968	1e-71	81
4493	3403	700381012H1	SATMON023	g1658321	BLASTN	949	1e-70	80
4494	3403	700243701H1	SATMON010	g1658321	BLASTN	874	1e-63	80
4495	3403	700220485H1	SATMON011	g664900	BLASTN	666	1e-54	74
4496	3403	700045165H1	SATMON004	g664900	BLASTN	734	1e-52	73
4497	3403	701185190H1	SATMONN06	g664900	BLASTN	709	1e-50	77
4498	3403	700552475H1	SATMON022	g664900	BLASTN	591	1e-49	81
4499	3403	700044755H1	SATMON004	g664900	BLASTN	690	1e-48	72
4500	3403	700051910H1	SATMON003	g664900	BLASTN	671	1e-47	77
4501	3403	700027425H1	SATMON003	g664900	BLASTN	675	1e-47	71
4502	3403	700048347H1	SATMON003	g664900	BLASTN	662	1e-46	71
4503	3403	700380608H1	SATMON021	g1658321	BLASTN	623	1e-43	82
4504	3403	700448484H1	SATMON027	g664900	BLASTN	522	1e-33	71
4505	3403	700184906H1	SATMON014	g2529342	BLASTX	251	1e-27	77
4506	3403	700048819H1	SATMON003	g664900	BLASTN	453	1e-27	74
4507	3403	701167994H1	SATMONN05	g2529342	BLASTX	193	1e-19	76
4508	8097	700084375H1	SATMON011	g664900	BLASTN	855	1e-76	79
4509	8097	700445226H1	SATMON027	g664900	BLASTN	464	1e-60	79
4510	8097	700240770H1	SATMON010	g664900	BLASTN	750	1e-60	80
4511	8097	700045122H1	SATMON004	g664900	BLASTN	638	1e-54	80
4512	3403	LIB3060-013-Q1-K1-A12	LIB3060	g664900	BLASTN	1052	1e-78	72
4513	3403	LIB3078-007-Q1-K1-G3	LIB3078	g664900	BLASTN	629	1e-41	69

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4514	-700045462	700045462H1	SATMON004	g2612940	BLASTN	1219	1e-92	89
4515	-700223919	700223919H1	SATMON011	g2612940	BLASTN	1025	1e-76	87
4516	-700256830	700256830H1	SATMON017	g2612940	BLASTN	1029	1e-76	87
4517	-701169515	701169515H1	SATMONN05	g2612940	BLASTN	327	1e-40	92
4518	23377	700263420H1	SATMON017	g2612940	BLASTN	489	1e-31	75
4519	23377	701185311H1	SATMONN06	g2612940	BLASTN	460	1e-27	78
4520	7446	700624329H1	SATMON034	g2612940	BLASTN	1046	1e-87	88
4521	7446	700159091H1	SATMON012	g2612940	BLASTN	898	1e-77	89
4522	-L30626416	LIB3062-048-Q1-K1-D12	LIB3062	g2612940	BLASTN	808	1e-74	86
4523	-L30684293	LIB3068-046-Q1-K1-B2	LIB3068	g2612940	BLASTN	846	1e-90	87
4524	28081	LIB36-007-Q1-E1-F12	LIB36	g2612940	BLASTN	521	1e-32	92

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4525	-700646481	700646481H1	SOYMON013	g1658321	BLASTN	967	1e-71	83
4526	-700734535	700734535H1	SOYMON010	g1658321	BLASTN	822	1e-59	82
4527	-700865886	700865886H1	SOYMON016	g1658321	BLASTN	568	1e-38	82
4528	-700943688	700943688H1	SOYMON024	g1658321	BLASTN	902	1e-66	82
4529	-700954594	700954594H1	SOYMON022	g2529342	BLASTX	172	1e-16	75
4530	-701064360	701064360H1	SOYMON034	g664901	BLASTX	179	1e-17	80
4531	1039	700662776H1	SOYMON005	g1658321	BLASTN	755	1e-78	83
4532	1039	700663764H1	SOYMON005	g1658321	BLASTN	839	1e-61	82



4587	3782	700870543H1	SOYMON018	g1658322	BLASTX	157	1e-25	68
4588	4096	700556949H1	SOYMON001	g664901	BLASTX	188	1e-18	92
4589	4096	700877014H1	SOYMON018	g664901	BLASTX	188	1e-18	92
4590	4096	700877022H1	SOYMON018	g664901	BLASTX	188	1e-18	92
4591	4096	700999039H1	SOYMON018	g664901	BLASTX	169	1e-16	91
4592	7870	700998419H1	SOYMON018	g1658321	BLASTN	430	1e-51	80
4593	7870	700557019H1	SOYMON001	g1658321	BLASTN	685	1e-48	80
4594	7870	700786020H2	SOYMON011	g1658321	BLASTN	531	1e-41	78
4595	7870	700740475H1	SOYMON012	g1658321	BLASTN	609	1e-41	74
4596	7870	700875020H1	SOYMON018	g1658321	BLASTN	525	1e-34	79
4597	7870	700674249H1	SOYMON007	g1658321	BLASTN	510	1e-33	82
4598	7870	700658256H1	SOYMON004	g2529342	BLASTX	178	1e-22	61
4599	7870	700677401H1	SOYMON007	g664901	BLASTX	158	1e-14	91
4600	9031	700874020H1	SOYMON018	g1658321	BLASTN	789	1e-56	79
4601	9031	700726463H1	SOYMON009	g1658321	BLASTN	758	1e-54	76
4602	9031	700869017H1	SOYMON016	g664900	BLASTN	743	1e-53	77
4603	9031	700566216H1	SOYMON002	g664901	BLASTX	201	1e-20	92
4604	1039	LIB3051-053-Q1-K2-F1	LIB3051	g1658321	BLASTN	1326	1e-101	80
4605	9031	LIB3039-045-Q1-E1-D1	LIB3039	g1658321	BLASTN	1033	1e-77	79

#### SOYBEAN PUTATIVE TRANSKETOLASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4606	19183	700907766H1	SOYMON022	g2612940	BLASTN	395	1e-30	68
4607	-700764341	700764341H1	SOYMON021	g2612941	BLASTX	247	1e-39	75
4608	-700888745	700888745H1	SOYMON024	g2612941	BLASTX	237	1e-27	76
4609	-700909473	700909473H1	SOYMON022	g2612941	BLASTX	114	1e-16	53
4610	7224	700681472H2	SOYMON008	g2612941	BLASTX	107	1e-12	72
4611	19325	700751059H1	SOYMON014	g2244912	BLASTX	160	1e-15	78
4612	-GM40396	LIB3051-093-Q1-K1-D2	LIB3051	g2612941	BLASTX	246	1e-73	90

#### MAIZE SEDOHEPTULOSE-1,7-BISPHOSPHATASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4613	1006	700423931H1	SATMONN01	g14265	BLASTX	128	1e-14	86
4614	29810	LIB36-010-Q1-E1-H12	LIB36	g2529375	BLASTN	911	1e-67	69

#### SOYBEAN SEDOHEPTULOSE-1,7-BISPHOSPHATASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4615	-700895707	700895707H1	SOYMON027	g2529375	BLASTN	696	1e-49	74
4616	24265	701154827H1	SOYMON031	g2529375	BLASTN	893	1e-65	83
4617	24265	701157439H1	SOYMON031	g2529375	BLASTN	851	1e-62	83
4618	3027	700988602H1	SOYMON009	g2529375	BLASTN	911	1e-67	77
4619	3027	701001010H1	SOYMON018	g2529375	BLASTN	915	1e-67	79
4620	3027	700997516H1	SOYMON018	g2529375	BLASTN	504	1e-60	80
4621	3027	700788686H1	SOYMON011	g2529375	BLASTN	837	1e-60	79
4622	3027	700556469H1	SOYMON001	g2529375	BLASTN	816	1e-59	76
4623	3027	700999494H1	SOYMON018	g2529375	BLASTN	806	1e-58	76
4624	3027	701106923H1	SOYMON036	g2529375	BLASTN	812	1e-58	78

4625	3027	700557386H1	SOYMON001	g2529375	BLASTN	473	1e-57	78
4626	3027	700996203H1	SOYMON018	g2529375	BLASTN	787	1e-56	79
4627	3027	700951860H1	SOYMON022	g2529375	BLASTN	771	1e-55	76
4628	3027	700683415H1	SOYMON008	g2529375	BLASTN	762	1e-54	79
4629	3027	700872306H1	SOYMON018	g2529375	BLASTN	734	1e-52	78
4630	3027	700876576H1	SOYMON018	g2529375	BLASTN	739	1e-52	79
4631	3027	700876860H1	SOYMON018	g2529375	BLASTN	741	1e-52	78
4632	3027	700874809H1	SOYMON018	g2529375	BLASTN	426	1e-50	76
4633	3027	700992772H1	SOYMON011	g2529375	BLASTN	707	1e-50	79
4634	3027	700740276H1	SOYMON012	g2529375	BLASTN	700	1e-49	76
4635	3027	700876171H1	SOYMON018	g786465	BLASTN	454	1e-47	80
4636	3027	700557859H1	SOYMON001	g2529375	BLASTN	633	1e-43	71
4637	3027	700556904H1	SOYMON001	g2529375	BLASTN	523	1e-42	70
4638	3027	701124349H1	SOYMON037	g2529375	BLASTN	565	1e-38	74
4639	3027	700554878H1	SOYMON001	g2529375	BLASTN	390	1e-36	68
4640	3027	700556561H1	SOYMON001	g2529375	BLASTN	540	1e-36	66
4641	3027	701001629H1	SOYMON018	g2529375	BLASTN	517	1e-34	66
4642	3027	700789624H2	SOYMON011	g2529375	BLASTN	507	1e-33	66
4643	3027	700993071H1	SOYMON011	g2529375	BLASTN	511	1e-33	66
4644	3027	700556185H1	SOYMON001	g2529375	BLASTN	513	1e-33	66
4645	3027	700554166H1	SOYMON001	g2529375	BLASTN	520	1e-33	66
4646	3027	700680116H2	SOYMON008	g2529375	BLASTN	486	1e-31	65
4647	3027	700557591H1	SOYMON001	g2529375	BLASTN	497	1e-31	66
4648	3027	701108330H1	SOYMON036	g2529375	BLASTN	486	1e-30	65
4649	3027	700875128H1	SOYMON018	g2529375	BLASTN	460	1e-29	65
4650	3027	700991275H1	SOYMON011	g2529375	BLASTN	462	1e-29	64
4651	3027	700556249H1	SOYMON001	g2529375	BLASTN	466	1e-28	65
4652	3027	700559069H1	SOYMON001	g2529375	BLASTN	467	1e-28	72
4653	3027	700990985H1	SOYMON011	g2529375	BLASTN	444	1e-27	62
4654	3027	701062648H1	SOYMON033	g2529375	BLASTN	438	1e-26	64
4655	3027	700560603H1	SOYMON001	g2529375	BLASTN	441	1e-26	73
4656	3027	701109375H1	SOYMON036	g2529376	BLASTX	128	1e-23	59
4657	3027	700787023H2	SOYMON011	g2529376	BLASTX	158	1e-21	55
4658	3027	701053814H1	SOYMON032	g2529376	BLASTX	127	1e-19	52
4659	3027	701103839H1	SOYMON036	g2529376	BLASTX	162	1e-17	60
4660	3027	700874009H1	SOYMON018	g2529376	BLASTX	180	1e-17	50
4661	3027	700557201H1	SOYMON001	g14265	BLASTX	154	1e-16	70
4662	3027	701001319H1	SOYMON018	g2529375	BLASTN	324	1e-16	59
4663	3027	701105211H1	SOYMON036	g2529376	BLASTX	159	1e-15	62
4664	3027	700558314H1	SOYMON001	g2529376	BLASTX	149	1e-13	47
4665	3027	700786134H2	SOYMON011	g2529376	BLASTX	76	1e-12	57
4666	3027	700875943H1	SOYMON018	g2529376	BLASTX	107	1e-12	42
4667	3027	700741681H1	SOYMON012	g2529376	BLASTX	108	1e-10	46
4668	3027	701001530H1	SOYMON018	g14265	BLASTX	128	1e-10	83
4669	3027	701109215H1	SOYMON036	g2529375	BLASTN	257	1e-10	60
4670	3027	700891544H1	SOYMON024	g2529376	BLASTX	123	1e-9	44
4671	3027	LIB3054-002-Q1-N1-B7	LIB3054	g2529375	BLASTN	1026	1e-76	71
4672	3027	LIB3055-004-Q1-N1-B1	LIB3055	g2529375	BLASTN	423	1e-74	80
4673	3027	LIB3053-006-Q1-N1-B2	LIB3053	g2529375	BLASTN	973	1e-72	71
4674	3027	LIB3055-008-Q1-N1-H3	LIB3055	g2529375	BLASTN	684	1e-63	69

4675	3027	LIB3055-011-Q1-N1-F4	LIB3055	g2529375	BLASTN	483	1e-33	77
4676	3027	LIB3030-005-Q1-B1-E5	LIB3030	g2529375	BLASTN	315	1e-31	65
4677	3027	LIB3054-003-Q1-N1-E12	LIB3054	g2529375	BLASTN	256	1e-10	60

#### MAIZE D-RIBULOSE-5-PHOSPHATE-3-EPIMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4678	-700222465	700222465H1	SATMON011	g1162980	BLASTX	149	1e-27	84
4679	-700618106	700618106H1	SATMON033	g902739	BLASTX	80	1e-25	76
4680	10201	700101610H1	SATMON009	g902738	BLASTN	1009	1e-75	80
4681	10201	700098237H1	SATMON009	g902738	BLASTN	1000	1e-74	80
4682	10201	700209605H1	SATMON016	g1162979	BLASTN	976	1e-72	78
4683	10201	700101988H1	SATMON009	g902738	BLASTN	626	1e-69	80
4684	10201	700091966H1	SATMON011	g902738	BLASTN	905	1e-66	80
4685	10201	700101445H1	SATMON009	g1162979	BLASTN	844	1e-61	80
4686	10201	700159349H1	SATMON012	g902738	BLASTN	681	1e-48	73
4687	10201	700380926H1	SATMON023	g902738	BLASTN	463	1e-45	81
4688	17215	700048475H1	SATMON003	g1008313	BLASTX	177	1e-17	61
4689	17215	700105805H1	SATMON010	g1008313	BLASTX	123	1e-10	59
4690	1795	700432796H1	SATMONN01	g902739	BLASTX	139	1e-12	93
4691	6043	700104089H1	SATMON010	g1162979	BLASTN	583	1e-39	79
4692	6043	700099362H1	SATMON009	g1162980	BLASTX	156	1e-29	71
4693	6043	700042321H1	SATMON004	g1162979	BLASTN	271	1e-27	79
4694	6043	700457795H1	SATMON029	g902739	BLASTX	132	1e-25	64
4695	6043	700096215H1	SATMON008	g1162980	BLASTX	120	1e-19	65
4696	6043	700378379H1	SATMON019	g1162980	BLASTX	119	1e-17	86
4697	6043	700239692H1	SATMON010	g1162980	BLASTX	167	1e-16	63
4698	6043	700093535H1	SATMON008	g1162980	BLASTX	120	1e-13	61
4699	6043	700098183H1	SATMON009	g1162980	BLASTX	121	1e-13	60
4700	6043	700093175H1	SATMON008	g902739	BLASTX	126	1e-12	59
4701	6043	700098056H1	SATMON009	g1162980	BLASTX	120	1e-9	57
4702	6043	700101650H1	SATMON009	g1162980	BLASTX	120	1e-9	57
4703	6043	700053356H1	SATMON009	g1162980	BLASTX	121	1e-9	57
4704	6043	700099441H1	SATMON009	g902739	BLASTX	122	1e-9	58
4705	7043	700162921H1	SATMON013	g1008313	BLASTX	130	1e-17	60
4706	7043	700552657H1	SATMON022	g902739	BLASTX	154	1e-16	51
4707	-L1891463	LIB189-001-Q1-E1-F4	LIB189	g1162979	BLASTN	596	1e-39	78
4708	-L30781313	LIB3078-002-Q1-K1-A2	LIB3078	g1162979	BLASTN	440	1e-25	79
4709	10201	LIB3078-034-Q1-K1-E8	LIB3078	g1162979	BLASTN	1271	1e-97	78
4710	10201	LIB189-018-Q1-E1-G1	LIB189	g902738	BLASTN	1263	1e-96	79
4711	10201	LIB3060-022-Q1-K1-G2	LIB3060	g902738	BLASTN	1228	1e-93	76
4712	10201	LIB3060-034-Q1-K1-D3	LIB3060	g902738	BLASTN	1205	1e-91	79
4713	10201	LIB36-007-Q1-E1-D10	LIB36	g1162979	BLASTN	989	1e-83	78
4714	10201	LIB3078-053-	LIB3078	g1162979	BLASTN	850	1e-62	68



4715	10201	Q1-K1-F4 LIB189-034- Q1-E1-B12	LIB189	g902738	BLASTN	761	1e-53	74
4716	1795	LIB3067-056- Q1-K1-A4	LIB3067	g902738	BLASTN	645	1e-43	80
4717	6043	LIB189-017- Q1-E1-F12	LIB189	g1162979	BLASTN	842	1e-61	78
4718	6043	LIB36-012- Q1-E1-H11	LIB36	g1162979	BLASTN	742	1e-51	78
4719	6043	LIB3060-018- Q1-K1-B5	LIB3060	g1162979	BLASTN	653	1e-43	77
4720	6043	LIB3062-015- Q1-K1-A11	LIB3062	g1162979	BLASTN	637	1e-42	77
4721	6043	LIB189-031- Q1-E1-D1	LIB189	g1162979	BLASTN	532	1e-33	76
4722	6043	LIB3060-013- Q1-K1-A2	LIB3060	g1162979	BLASTN	466	1e-27	75
4723	7043	LIB148-032- Q1-E1-A4	LIB148	g2564973	BLASTX	238	1e-42	48

#### SOYBEAN D-RIBULOSE-5-PHOSPHATE-3-EPIMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4724	-700677209	700677209H1	SOYMON007	g1162980	BLASTX	130	1e-30	85
4725	10469	700971857H1	SOYMON005	g1008313	BLASTX	208	1e-27	55
4726	10469	701064495H1	SOYMON034	g1008313	BLASTX	208	1e-27	56
4727	10469	701007767H1	SOYMON019	g1008313	BLASTX	129	1e-25	54
4728	10469	700656367H1	SOYMON004	g1008313	BLASTX	182	1e-22	57
4729	15209	700791582H1	SOYMON011	g2388956	BLASTX	129	1e-10	66
4730	15209	701001180H1	SOYMON018	g1008313	BLASTX	122	1e-9	65
4731	18337	700739263H1	SOYMON012	g902738	BLASTN	481	1e-50	82
4732	18337	700681545H1	SOYMON008	g1162979	BLASTN	342	1e-44	83
4733	18818	700866167H1	SOYMON016	g1162979	BLASTN	853	1e-62	89
4734	18818	700983968H1	SOYMON009	g1162979	BLASTN	422	1e-55	76
4735	5784	700999796H1	SOYMON018	g1162979	BLASTN	535	1e-43	78
4736	5784	700788240H1	SOYMON011	g902738	BLASTN	455	1e-36	77
4737	5784	701000905H1	SOYMON018	g902738	BLASTN	501	1e-36	77
4738	5784	701040171H1	SOYMON029	g902738	BLASTN	510	1e-33	78
4739	5784	700754807H1	SOYMON014	g902738	BLASTN	447	1e-31	72
4740	5784	700904930H1	SOYMON022	g902738	BLASTN	465	1e-29	77
4741	5784	700739828H1	SOYMON012	g902738	BLASTN	455	1e-28	76
4742	5784	700741008H1	SOYMON012	g1162980	BLASTX	142	1e-16	81
4743	5784	700738184H1	SOYMON012	g1162980	BLASTX	167	1e-16	81
4744	5784	700790753H1	SOYMON011	g1162980	BLASTX	149	1e-15	79
4745	5784	701110183H1	SOYMON036	g1162980	BLASTX	161	1e-15	81
4746	5784	700876264H1	SOYMON018	g1162980	BLASTX	140	1e-12	87
4747	5784	700787492H2	SOYMON011	g1162980	BLASTX	141	1e-12	76
4748	5784	700788242H1	SOYMON011	g1162980	BLASTX	80	1e-11	89
4749	5784	700741612H1	SOYMON012	g1162980	BLASTX	103	1e-11	78
4750	5784	700789926H2	SOYMON011	g1162980	BLASTX	119	1e-11	74
4751	5784	701105542H1	SOYMON036	g1162980	BLASTX	117	1e-10	66
4752	5784	700741161H1	SOYMON012	g1162980	BLASTX	101	1e-8	63
4753	5784	700877044H1	SOYMON018	g902738	BLASTN	236	1e-8	73
4754	9624	700659817H1	SOYMON004	g1162979	BLASTN	959	1e-71	85

4755	9624	700558457H1	SOYMON001	g1162979	BLASTN	533	1e-64	81
4756	9624	700898624H1	SOYMON027	g1162979	BLASTN	867	1e-63	83
4757	9624	700848716H1	SOYMON021	g1162979	BLASTN	680	1e-61	83
4758	9624	700990488H1	SOYMON011	g1162979	BLASTN	763	1e-54	83
4759	9624	700980873H1	SOYMON009	g1162979	BLASTN	722	1e-51	77
4760	9624	700654880H1	SOYMON004	g1162979	BLASTN	473	1e-36	71
4761	10469	LIB3040-057-Q1-E1-C5	LIB3040	g1008313	BLASTX	205	1e-60	54
4762	9624	LIB3030-001-Q1-B1-F10	LIB3030	g1162979	BLASTN	1185	1e-90	80

#### MAIZE RIBOSE-5-PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4763	5053	700206243H1	SATMON003	g1669358	BLASTX	165	1e-20	59
4764	5053	700157368H1	SATMON012	g1001678	BLASTX	188	1e-19	59
4765	-L30672312	LIB3067-007-Q1-K1-C3	LIB3067	g1789280	BLASTX	114	1e-24	54
4766	-L841459	LIB84-028-Q1-E1-A11	LIB84	g1789280	BLASTX	117	1e-25	53
4767	5053	LIB3078-033-Q1-K1-A2	LIB3078	g1001678	BLASTX	217	1e-42	50
4768	5053	LIB3060-054-Q1-K1-G1	LIB3060	g2649655	BLASTX	100	1e-34	48
4769	5053	LIB3078-054-Q1-K1-B9	LIB3078	g1669358	BLASTX	65	1e-24	40

#### MAIZE PUTATIVE RIBOSE-5-PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4770	-700622640	700622640H1	SATMON034	g3257798	BLASTX	128	1e-10	63
4771	5053	700213140H1	SATMON016	g500774	BLASTX	195	1e-20	43

#### SOYBEAN RIBOSE-5-PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4772	17047	700737894H1	SOYMON012	g1001678	BLASTX	93	1e-14	62
4773	17047	700790677H2	SOYMON011	g2649655	BLASTX	68	1e-9	47
4774	17047	700891079H1	SOYMON024	g1001678	BLASTX	122	1e-9	56
4775	8783	701120985H1	SOYMON037	g1789280	BLASTX	115	1e-9	51
4776	8783	700745725H1	SOYMON013	g1789280	BLASTX	113	1e-8	51

#### SOYBEAN PUTATIVE RIBOSE-5-PHOSPHATE ISOMERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4777	-700840778	700840778H1	SOYMON020	g500774	BLASTX	203	1e-21	51
4778	-700898355	700898355H1	SOYMON027	g3257798	BLASTX	108	1e-17	60
4779	16333	700562390H1	SOYMON002	g500774	BLASTX	211	1e-22	44
4780	16333	700961206H1	SOYMON022	g500774	BLASTX	145	1e-14	51
4781	8873	701120413H1	SOYMON037	g3257798	BLASTX	134	1e-11	48

# MAIZE RIBOSE-5-PHOSPHATE KINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4782	-700427028	700427028H1	SATMONN01	g1885326	BLASTX	88	1e-11	60
4783	-700441954	700441954H1	SATMON026	g21840	BLASTN	186	1e-16	72
4784	-700448070	700448070H1	SATMON027	g16440	BLASTN	289	1e-39	75
4785	-700581778	700581778H1	SATMON031	g16441	BLASTX	117	1e-14	76
4786	3680	700044442H1	SATMON004	g21840	BLASTN	1134	1e-85	89
4787	3680	700044434H1	SATMON004	g21840	BLASTN	1122	1e-84	89
4788	3680	700430775H1	SATMONN01	g21840	BLASTN	1109	1e-83	87
4789	3680	700043261H1	SATMON004	g21840	BLASTN	1097	1e-82	90
4790	3680	700101266H1	SATMON009	g21840	BLASTN	1098	1e-82	88
4791	3680	700440552H1	SATMON026	g21840	BLASTN	1047	1e-78	89
4792	3680	700430385H1	SATMONN01	g21838	BLASTN	964	1e-71	88
4793	3680	700441643H1	SATMON026	g21840	BLASTN	852	1e-62	84
4794	3680	700042294H1	SATMON004	g21838	BLASTN	842	1e-61	86
4795	7956	700099212H1	SATMON009	g21840	BLASTN	1192	1e-90	86
4796	7956	700099715H1	SATMON009	g21840	BLASTN	1066	1e-80	85
4797	7956	700100470H1	SATMON009	g21840	BLASTN	925	1e-68	79
4798	7956	700438420H1	SATMON026	g21840	BLASTN	921	1e-67	84
4799	7956	700353611H1	SATMON024	g21838	BLASTN	812	1e-58	77
4800	7956	700100342H1	SATMON009	g21838	BLASTN	665	1e-46	76
4801	7956	700043758H1	SATMON004	g21840	BLASTN	394	1e-44	74
4802	7956	700100269H1	SATMON009	g21838	BLASTN	510	1e-32	73
4803	7956	700099313H1	SATMON009	g21838	BLASTN	516	1e-32	73
4804	7956	700097674H1	SATMON009	g21839	BLASTX	162	1e-30	76
4805	7956	700097907H1	SATMON009	g21840	BLASTN	455	1e-27	72
4806	7956	700098314H1	SATMON009	g21838	BLASTN	460	1e-27	72
4807	7956	700098714H1	SATMON009	g21840	BLASTN	462	1e-27	72
4808	7956	700101077H1	SATMON009	g21840	BLASTN	417	1e-24	69
4809	7956	700439560H1	SATMON026	g21838	BLASTN	421	1e-24	89
4810	7956	700094395H1	SATMON008	g21840	BLASTN	424	1e-24	70
4811	7956	700208768H1	SATMON016	g21840	BLASTN	424	1e-24	70
4812	7956	700100913H1	SATMON009	g21840	BLASTN	424	1e-24	70
4813	7956	700042685H1	SATMON004	g21840	BLASTN	401	1e-23	75
4814	7956	700097183H1	SATMON009	g21840	BLASTN	407	1e-23	75
4815	7956	700101216H1	SATMON009	g21839	BLASTX	97	1e-15	72
4816	-L361538	LIB36-008-Q1-E1-F4	LIB36	g21840	BLASTN	707	1e-48	82
4817	3680	LIB189-012-Q1-E1-H11	LIB189	g21840	BLASTN	1443	1e-130	86
4818	3680	LIB3078-011-Q1-K1-B10	LIB3078	g21840	BLASTN	1659	1e-129	88
4819	3680	LIB3066-004-Q1-K1-D6	LIB3066	g21840	BLASTN	1648	1e-128	87
4820	3680	LIB3060-025-Q1-K1-F6	LIB3060	g21840	BLASTN	1604	1e-127	88
4821	3680	LIB189-006-Q1-E1-A5	LIB189	g21840	BLASTN	1380	1e-106	89
4822	3680	LIB36-001-Q1-E1-G1	LIB36	g21840	BLASTN	1329	1e-101	78
4823	3680	LIB84-013-Q1-E1-B8	LIB84	g21840	BLASTN	919	1e-82	85
4824	3680	LIB36-014-Q1-E1-D8	LIB36	g21838	BLASTN	870	1e-70	86

4825	3680	LIB36-017-Q1-E1-H3	LIB36	g21838	BLASTN	589	1e-43	85
4826	7956	LIB189-029-Q1-E1-D12	LIB189	g21840	BLASTN	1559	1e-121	84
4827	7956	LIB3078-055-Q1-K1-D12	LIB3078	g21840	BLASTN	1370	1e-105	82
4828	7956	LIB36-020-Q1-E1-D1	LIB36	g21838	BLASTN	908	1e-93	76
4829	7956	LIB36-013-Q1-E1-B5	LIB36	g21838	BLASTN	792	1e-83	76
4830	7956	LIB3060-028-Q1-K1-B7	LIB3060	g21840	BLASTN	470	1e-73	76
4831	7956	LIB189-020-Q1-E1-B11	LIB189	g21840	BLASTN	411	1e-45	74
4832	7956	LIB3062-047-Q1-K1-H1	LIB3062	g21840	BLASTN	419	1e-28	71

#### SOYBEAN RIBOSE-5-PHOSPHATE KINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4833	-700657358	700657358H1	SOYMON004	g16441	BLASTX	134	1e-16	95
4834	-700790008	700790008H2	SOYMON011	g1885325	BLASTN	725	1e-51	75
4835	-700872439	700872439H1	SOYMON018	g1885325	BLASTN	562	1e-38	75
4836	4157	701055931H1	SOYMON032	g1885325	BLASTN	1147	1e-86	91
4837	4157	700680979H1	SOYMON008	g1885325	BLASTN	981	1e-84	85
4838	4157	700990472H1	SOYMON011	g1885325	BLASTN	1114	1e-84	88
4839	4157	700556547H1	SOYMON001	g1885325	BLASTN	1079	1e-81	87
4840	4157	700684029H1	SOYMON008	g1885325	BLASTN	1066	1e-80	87
4841	4157	700684302H1	SOYMON008	g1885325	BLASTN	1042	1e-78	89
4842	4157	700877162H1	SOYMON018	g1885325	BLASTN	922	1e-76	87
4843	4157	700875857H1	SOYMON018	g1885325	BLASTN	1021	1e-76	90
4844	4157	700875895H1	SOYMON018	g1885325	BLASTN	1027	1e-76	90
4845	4157	700791057H1	SOYMON011	g1885325	BLASTN	785	1e-75	89
4846	4157	700990257H1	SOYMON011	g1885325	BLASTN	1003	1e-74	86
4847	4157	700991766H1	SOYMON011	g1885325	BLASTN	622	1e-73	86
4848	4157	700875789H1	SOYMON018	g1885325	BLASTN	787	1e-71	90
4849	4157	700791651H1	SOYMON011	g1885325	BLASTN	949	1e-70	87
4850	4157	701106902H1	SOYMON036	g1885325	BLASTN	925	1e-68	85
4851	4157	700739192H1	SOYMON012	g1885325	BLASTN	916	1e-67	90
4852	4157	700681723H1	SOYMON008	g1885325	BLASTN	902	1e-66	85
4853	4157	700755385H1	SOYMON014	g1885325	BLASTN	883	1e-64	84
4854	4157	700870864H1	SOYMON018	g1885325	BLASTN	865	1e-63	78
4855	4157	701107593H1	SOYMON036	g1885325	BLASTN	872	1e-63	84
4856	4157	701002558H1	SOYMON018	g1885325	BLASTN	617	1e-62	84
4857	4157	700875430H1	SOYMON018	g1885325	BLASTN	860	1e-62	83
4858	4157	700654704H1	SOYMON004	g1885325	BLASTN	535	1e-58	86
4859	4157	701070469H1	SOYMON034	g1885325	BLASTN	214	1e-18	92
4860	4157	700739393H1	SOYMON012	g16441	BLASTX	182	1e-17	94
4861	4157	700657046H1	SOYMON004	g1885325	BLASTN	141	1e-10	86
4862	6097	700984236H1	SOYMON009	g1885325	BLASTN	1039	1e-77	87
4863	6097	701109839H1	SOYMON036	g1885325	BLASTN	952	1e-70	88
4864	6097	700731201H1	SOYMON009	g1885325	BLASTN	885	1e-64	85
4865	668	700959747H1	SOYMON022	g1885325	BLASTN	414	1e-65	84
4866	668	700994042H1	SOYMON011	g1885325	BLASTN	863	1e-63	82

4867	668	700899089H1	SOYMON027	g1885325	BLASTN	849	1e-61	84
4868	668	700787854H2	SOYMON011	g167265	BLASTN	330	1e-47	84
4869	668	700873392H1	SOYMON018	g167265	BLASTN	530	1e-35	85
4870	668	700553732H1	SOYMON001	g167265	BLASTN	483	1e-30	84
4871	668	700560501H1	SOYMON001	g167265	BLASTN	460	1e-27	84
4872	668	701105881H1	SOYMON036	g167265	BLASTN	439	1e-26	84
4873	668	700681112H2	SOYMON008	g167265	BLASTN	395	1e-22	85
4874	668	700997513H1	SOYMON018	g167265	BLASTN	383	1e-21	84
4875	668	700763831H1	SOYMON018	g167266	BLASTX	131	1e-16	84
4876	668	701055857H1	SOYMON032	g167266	BLASTX	163	1e-15	94
4877	668	700559450H1	SOYMON001	g167265	BLASTN	273	1e-15	78
4878	668	701000176H1	SOYMON018	g167266	BLASTX	155	1e-14	93
4879	668	700996108H1	SOYMON018	g167266	BLASTX	158	1e-14	84
4880	668	700791528H1	SOYMON011	g167265	BLASTN	298	1e-14	84
4881	668	700901050H1	SOYMON027	g167265	BLASTN	288	1e-13	83
4882	668	700979790H2	SOYMON009	g167265	BLASTN	288	1e-13	81
4883	668	700877128H1	SOYMON018	g167265	BLASTN	290	1e-13	74
4884	668	700743001H1	SOYMON012	g167266	BLASTX	140	1e-12	78
4885	668	700995911H1	SOYMON018	g167265	BLASTN	197	1e-12	86
4886	668	701106835H1	SOYMON036	g167265	BLASTN	278	1e-12	89
4887	668	700675621H1	SOYMON007	g167265	BLASTN	261	1e-11	75
4888	668	701002519H1	SOYMON018	g167266	BLASTX	125	1e-10	83
4889	668	700686660H1	SOYMON008	g167266	BLASTX	130	1e-10	83
4890	668	700738677H1	SOYMON012	g167265	BLASTN	196	1e-10	89
4891	668	700963637H1	SOYMON022	g167265	BLASTN	196	1e-10	88
4892	668	700791287H1	SOYMON011	g167265	BLASTN	236	1e-10	82
4893	668	700553943H1	SOYMON001	g167265	BLASTN	258	1e-10	83
4894	668	700876063H1	SOYMON018	g167266	BLASTX	116	1e-9	92
4895	668	700555924H1	SOYMON001	g167266	BLASTX	118	1e-9	79
4896	668	700686037H1	SOYMON008	g167265	BLASTN	249	1e-9	81
4897	668	700791185H1	SOYMON011	g167265	BLASTN	249	1e-9	86
4898	8098	700726396H1	SOYMON009	g1885325	BLASTN	711	1e-54	87
4899	8098	700683768H1	SOYMON008	g1885325	BLASTN	614	1e-45	87
4900	8098	700741625H1	SOYMON012	g1885325	BLASTN	479	1e-37	88
4901	8098	700737803H1	SOYMON012	g1885325	BLASTN	441	1e-29	86
4902	8098	700995703H1	SOYMON011	g1885325	BLASTN	286	1e-14	85
4903	4157	LIB3055-013-Q1-N1-F6	LIB3055	g1885325	BLASTN	1123	1e-131	87
4904	4157	LIB3028-012-Q1-B1-F10	LIB3028	g1885325	BLASTN	645	1e-82	81
4905	668	LIB3039-054-Q1-E1-C11	LIB3039	g167265	BLASTN	815	1e-64	80
4906	668	LIB3055-013-Q1-N1-D11	LIB3055	g167265	BLASTN	817	1e-59	83
4907	668	LIB3055-013-Q1-N1-H7	LIB3055	g167265	BLASTN	676	1e-45	79
4908	668	LIB3055-004-Q1-N1-F5	LIB3055	g1885325	BLASTN	318	1e-36	83

MAIZE PHOSPHOENOLPYRUVATE CARBOXYLASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
4909	-700029657	700029657H1	SATMON003	g22614	BLASTN	275	1e-13	83
4910	-700043027	700043027H1	SATMON004	g22407	BLASTN	497	1e-38	80

4911	-700073205	700073205H1	SATMON007	g3132309	BLASTN	1480	1e-114	100
4912	-700073954	700073954H1	SATMON007	g22614	BLASTN	243	1e-28	79
4913	-700075634	700075634H1	SATMON007	g3132309	BLASTN	471	1e-75	83
4914	-700076492	700076492H1	SATMON007	g429148	BLASTN	909	1e-109	98
4915	-700097250	700097250H1	SATMON009	g22396	BLASTN	366	1e-21	88
4916	-700100473	700100473H1	SATMON009	g22407	BLASTN	644	1e-63	98
4917	-700101359	700101359H1	SATMON009	g22415	BLASTN	1530	1e-118	99
4918	-700152625	700152625H1	SATMON007	g3132309	BLASTN	1154	1e-87	99
4919	-700154435	700154435H1	SATMON007	g3132309	BLASTN	761	1e-54	98
4920	-700162895	700162895H1	SATMON013	g169843	BLASTN	438	1e-27	85
4921	-700201740	700201740H1	SATMON003	g21629	BLASTN	498	1e-32	86
4922	-700224677	700224677H1	SATMON011	g429148	BLASTN	729	1e-84	95
4923	-700238706	700238706H1	SATMON010	g429148	BLASTN	1431	1e-110	99
4924	-700257537	700257537H1	SATMON017	g22409	BLASTN	391	1e-50	91
4925	-700331923	700331923H1	SATMON019	g429148	BLASTN	1338	1e-102	97
4926	-700356223	700356223H1	SATMON024	g21629	BLASTN	471	1e-79	96
4927	-700356594	700356594H1	SATMON024	g21629	BLASTN	117	1e-8	95
4928	-700428887	700428887H1	SATMONN01	g22407	BLASTN	303	1e-31	85
4929	-700429388	700429388H1	SATMONN01	g22468	BLASTN	221	1e-22	89
4930	-700441559	700441559H1	SATMON026	g22396	BLASTN	194	1e-10	90
4931	-700552009	700552009H1	SATMON022	g169843	BLASTN	739	1e-84	94
4932	-700578607	700578607H1	SATMON031	g22390	BLASTN	380	1e-35	99
4933	-701169553	701169553H1	SATMONN05	g18463	BLASTN	271	1e-13	66
4934	10799	700074427H1	SATMON007	g3132309	BLASTN	1458	1e-112	99
4935	10799	700154441H1	SATMON007	g3132309	BLASTN	1090	1e-81	100
4936	1418	700097963H1	SATMON009	g22396	BLASTN	1635	1e-127	100
4937	1418	700097754H1	SATMON009	g22415	BLASTN	1080	1e-124	100
4938	1418	700097792H1	SATMON009	g22407	BLASTN	1598	1e-124	99
4939	1418	700098551H1	SATMON009	g22407	BLASTN	1296	1e-123	97
4940	1418	700098302H1	SATMON009	g22415	BLASTN	1588	1e-123	99
4941	1418	700098121H1	SATMON009	g22415	BLASTN	1582	1e-122	99
4942	1418	700101619H1	SATMON009	g22396	BLASTN	1561	1e-121	99
4943	1418	700098581H1	SATMON009	g22415	BLASTN	1571	1e-121	98
4944	1418	700099632H1	SATMON009	g22407	BLASTN	1556	1e-120	99
4945	1418	700101969H1	SATMON009	g22562	BLASTN	1539	1e-119	99
4946	1418	700083104H1	SATMON011	g22415	BLASTN	1082	1e-118	97
4947	1418	700100275H1	SATMON009	g22407	BLASTN	1534	1e-118	99
4948	1418	700098816H1	SATMON009	g22562	BLASTN	926	1e-117	98
4949	1418	700101994H1	SATMON009	g22415	BLASTN	1512	1e-117	99
4950	1418	700101641H1	SATMON009	g22396	BLASTN	1515	1e-117	100
4951	1418	700101001H1	SATMON009	g22415	BLASTN	1500	1e-116	100
4952	1418	700099730H1	SATMON009	g22396	BLASTN	1500	1e-116	100
4953	1418	700097140H1	SATMON009	g22562	BLASTN	1506	1e-116	99
4954	1418	700100324H1	SATMON009	g22415	BLASTN	1260	1e-115	100
4955	1418	700098727H1	SATMON009	g22415	BLASTN	1487	1e-115	99
4956	1418	700097485H1	SATMON009	g22415	BLASTN	1496	1e-115	99
4957	1418	700097789H1	SATMON009	g22407	BLASTN	1479	1e-114	99
4958	1418	700099540H1	SATMON009	g22415	BLASTN	1485	1e-114	100
4959	1418	700097905H1	SATMON009	g22415	BLASTN	1224	1e-113	98
4960	1418	700099338H1	SATMON009	g22407	BLASTN	1248	1e-113	99
4961	1418	700101618H1	SATMON009	g22415	BLASTN	1395	1e-113	100
4962	1418	700100382H1	SATMON009	g22415	BLASTN	1465	1e-113	100
4963	1418	700097861H1	SATMON009	g22396	BLASTN	1473	1e-113	99
4964	1418	700099369H1	SATMON009	g22415	BLASTN	1457	1e-112	99

4965	1418	700097270H1	SATMON009	g22407	BLASTN	1383	1e-111	97
4966	1418	700042158H1	SATMON004	g22415	BLASTN	1440	1e-111	100
4967	1418	700097169H1	SATMON009	g22415	BLASTN	1427	1e-110	97
4968	1418	700099238H1	SATMON009	g22415	BLASTN	1428	1e-110	99
4969	1418	700045908H1	SATMON004	g22415	BLASTN	1424	1e-109	97
4970	1418	700101654H1	SATMON009	g22415	BLASTN	985	1e-108	99
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4975	1418	700101507H1	SATMON009	g22415	BLASTN	927	1e-107	98
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4983	1418	700099760H1	SATMON009	g22415	BLASTN	751	1e-105	97
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5024	1418	700098977H1	SATMON009	g22562	BLASTN	933	1e-94	97
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5040	1418	700439340H1	SATMON026	g22415	BLASTN	725	1e-76	97
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5107	201	700612494H1	SATMON033	g3132309	BLASTN	341	1e-28	97
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5117	2554	700160214H1	SATMON012	g429148	BLASTN	1310	1e-100	100
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5123	2724	700087946H1	SATMON011	g429148	BLASTN	1103	1e-83	99
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5157	8340	700077313H1	SATMON007	g3132309	BLASTN	1575	1e-122	100
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5159	8340	700574357H2	SATMON030	g3132309	BLASTN	1040	1e-100	100
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5161	8340	700029043H1	SATMON003	g3132309	BLASTN	1273	1e-97	99
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5163	8340	700167824H1	SATMON013	g3132309	BLASTN	1190	1e-90	100
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5166	8340	700265822H1	SATMON017	g3132309	BLASTN	755	1e-54	100
5167	9226	700223020H1	SATMON011	g169843	BLASTN	1098	1e-82	92
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5169	-L1437153	LIB143-036-Q1-E1-D6	LIB143	g18463	BLASTN	262	1e-12	66
5170	-L1482958	LIB148-011-Q1-E1-D6	LIB148	g18463	BLASTN	211	1e-8	72
5171	-L1893647	LIB189-031-Q1-E1-H12	LIB189	g22407	BLASTN	888	1e-76	81
5172	-L30596200	LIB3059-060-Q1-K1-G6	LIB3059	g169843	BLASTN	276	1e-11	76
5173	-L30602129	LIB3060-009-Q1-K1-C3	LIB3060	g22415	BLASTN	369	1e-70	91
5174	-L30602452	LIB3060-011-Q1-K1-F9	LIB3060	g22396	BLASTN	198	1e-15	82

5175	-L30603203	LIB3060-029-Q1-K1-A8	LIB3060	g22407	BLASTN	1486	1e-114	83
5176	-L30604116	LIB3060-040-Q1-K1-D7	LIB3060	g18463	BLASTN	260	1e-12	64
5177	-L30604857	LIB3060-020-Q1-K1-G9	LIB3060	g22407	BLASTN	459	1e-40	86
5178	-L30606181	LIB3060-019-Q1-K1-B5	LIB3060	g22407	BLASTN	254	1e-38	69
5179	-L30684867	LIB3068-040-Q1-K1-A3	LIB3068	g18463	BLASTN	216	1e-9	69
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5181	-L30686577	LIB3068-010-Q1-K1-E2	LIB3068	g18463	BLASTN	209	1e-8	71
5182	-L30695246	LIB3069-036-Q1-K1-G3	LIB3069	g169843	BLASTN	257	1e-10	79
5183	-L30695363	LIB3069-035-Q1-K1-D7	LIB3069	g429148	BLASTN	371	1e-35	91
5184	-L30782259	LIB3078-007-Q1-K1-E3	LIB3078	g22415	BLASTN	548	1e-46	72
5185	-L30783285	LIB3078-051-Q1-K1-F1	LIB3078	g22415	BLASTN	941	1e-84	78
5186	-L361508	LIB36-008-Q1-E1-B4	LIB36	g22415	BLASTN	825	1e-59	90
5187	-L362677	LIB36-007-Q1-E1-G11	LIB36	g22614	BLASTN	235	1e-8	77
5188	-L841179	LIB84-013-Q1-E1-A10	LIB84	g22415	BLASTN	594	1e-40	81
5189	-L841868	LIB84-029-Q1-E1-F12	LIB84	g18463	BLASTN	237	1e-10	66
5190	1418	LIB36-002-Q1-E1-G4	LIB36	g22562	BLASTN	2116	1e-177	99
5191	1418	LIB36-002-Q1-E1-E9	LIB36	g22562	BLASTN	2184	1e-173	98
5192	1418	LIB36-002-Q1-E1-D11	LIB36	g22415	BLASTN	2175	1e-172	98
5193	1418	LIB3060-035-Q1-K1-E11	LIB3060	g22415	BLASTN	2143	1e-169	98
5194	1418	LIB3060-003-Q1-K1-E12	LIB3060	g22407	BLASTN	2003	1e-168	98
5195	1418	LIB3060-012-Q1-K1-F9	LIB3060	g22407	BLASTN	2127	1e-168	98
5196	1418	LIB36-009-Q1-E1-D9	LIB36	g22396	BLASTN	2133	1e-168	99
5197	1418	LIB3078-014-Q1-K1-G9	LIB3078	g22415	BLASTN	2117	1e-167	99
5198	1418	LIB36-003-Q1-E1-G4	LIB36	g22396	BLASTN	2107	1e-166	98
5199	1418	LIB3060-016-Q1-K1-A6	LIB3060	g22407	BLASTN	2096	1e-165	99
5200	1418	LIB3060-021-Q1-K1-E1	LIB3060	g22415	BLASTN	1532	1e-164	97
5201	1418	LIB36-013-Q1-E1-A10	LIB36	g22415	BLASTN	2067	1e-163	98

5202	1418	LIB36-012-Q1-E1-E3	LIB36	g22415	BLASTN	1865	1e-161	97
5203	1418	LIB36-003-Q1-E1-B9	LIB36	g22415	BLASTN	2048	1e-161	97
5204	1418	LIB3078-015-Q1-K1-F11	LIB3078	g22396	BLASTN	2005	1e-158	99
5205	1418	LIB189-024-Q1-E1-A11	LIB189	g22396	BLASTN	2007	1e-158	99
5206	1418	LIB36-002-Q1-E1-C1	LIB36	g22415	BLASTN	2013	1e-158	92
5207	1418	LIB3078-056-Q1-K1-B2	LIB3078	g22562	BLASTN	1612	1e-157	90
5208	1418	LIB3060-048-Q1-K1-A9	LIB3060	g22415	BLASTN	1824	1e-156	92
5209	1418	LIB189-011-Q1-E1-F6	LIB189	g22415	BLASTN	1849	1e-156	96
5210	1418	LIB3060-054-Q1-K1-E7	LIB3060	g22415	BLASTN	1912	1e-156	96
5211	1418	LIB3078-016-Q1-K1-C2	LIB3078	g22562	BLASTN	1960	1e-156	99
5212	1418	LIB3060-009-Q1-K1-C11	LIB3060	g22562	BLASTN	1626	1e-155	94
5213	1418	LIB36-003-Q1-E1-F7	LIB36	g22562	BLASTN	1841	1e-154	97
5214	1418	LIB3060-045-Q1-K1-B2	LIB3060	g22407	BLASTN	1353	1e-153	95
5215	1418	LIB3060-052-Q1-K1-B6	LIB3060	g22407	BLASTN	1041	1e-152	95
5216	1418	LIB36-018-Q1-E1-D4	LIB36	g22415	BLASTN	1637	1e-152	92
5217	1418	LIB189-024-Q1-E1-E3	LIB189	g22396	BLASTN	1939	1e-152	93
5218	1418	LIB36-010-Q1-E1-H4	LIB36	g22396	BLASTN	1004	1e-151	94
5219	1418	LIB3060-012-Q1-K1-B10	LIB3060	g22415	BLASTN	1532	1e-150	90
5220	1418	LIB3060-019-Q1-K1-G7	LIB3060	g22415	BLASTN	1919	1e-150	97
5221	1418	LIB36-022-Q1-E1-E7	LIB36	g22562	BLASTN	1851	1e-149	95
5222	1418	LIB3060-021-Q1-K1-C2	LIB3060	g22562	BLASTN	869	1e-147	94
5223	1418	LIB3060-053-Q1-K1-D6	LIB3060	g22415	BLASTN	1578	1e-145	93
5224	1418	LIB189-006-Q1-E1-D4	LIB189	g22415	BLASTN	1682	1e-145	99
5225	1418	LIB3060-011-Q1-K1-A5	LIB3060	g22415	BLASTN	1712	1e-144	96
5226	1418	LIB189-022-Q1-E1-H8	LIB189	g22562	BLASTN	1774	1e-144	96
5227	1418	LIB3061-017-Q1-K1-E11	LIB3061	g22562	BLASTN	1533	1e-142	93
5228	1418	LIB83-002-Q1-E1-E1	LIB83	g22415	BLASTN	1122	1e-140	95

5229	1418	LIB3060-020-Q1-K1-C10	LIB3060	g22415	BLASTN	1542	1e-139	93
5230	1418	LIB3060-041-Q1-K1-G7	LIB3060	g22407	BLASTN	1602	1e-136	98
5231	1418	LIB189-016-Q1-E1-C1	LIB189	g22562	BLASTN	1318	1e-135	95
5232	1418	LIB189-031-Q1-E1-H11	LIB189	g22415	BLASTN	1613	1e-134	95
5233	1418	LIB189-028-Q1-E1-B6	LIB189	g22562	BLASTN	1600	1e-130	100
5234	1418	LIB36-019-Q1-E1-A5	LIB36	g22415	BLASTN	1245	1e-129	96
5235	1418	LIB3060-023-Q1-K1-G11	LIB3060	g22415	BLASTN	1650	1e-128	81
5236	1418	LIB36-018-Q1-E1-A4	LIB36	g22396	BLASTN	1228	1e-127	96
5237	1418	LIB3060-008-Q1-K1-B10	LIB3060	g22396	BLASTN	1570	1e-126	99
5238	1418	LIB83-009-Q1-E1-A11	LIB83	g22562	BLASTN	1421	1e-123	98
5239	1418	LIB189-002-Q1-E1-B7	LIB189	g22562	BLASTN	1477	1e-122	99
5240	1418	LIB3060-045-Q1-K1-B1	LIB3060	g22562	BLASTN	1078	1e-121	90
5241	1418	LIB36-007-Q1-E1-A11	LIB36	g22415	BLASTN	1536	1e-119	98
5242	1418	LIB36-006-Q1-E1-D3	LIB36	g22407	BLASTN	1304	1e-117	97
5243	1418	LIB36-002-Q1-E1-E7	LIB36	g22396	BLASTN	1505	1e-116	94
5244	1418	LIB36-012-Q1-E1-F6	LIB36	g22396	BLASTN	1241	1e-113	97
5245	1418	LIB189-032-Q1-E1-E4	LIB189	g22407	BLASTN	803	1e-106	92
5246	1418	LIB36-018-Q1-E1-H1	LIB36	g22396	BLASTN	916	1e-104	92
5247	1418	LIB3078-023-Q1-K1-H1	LIB3078	g22396	BLASTN	1052	1e-96	84
5248	1418	LIB3060-019-Q1-K1-E7	LIB3060	g22415	BLASTN	1109	1e-96	88
5249	1418	LIB3060-042-Q1-K1-E5	LIB3060	g22407	BLASTN	1236	1e-94	94
5250	1418	LIB3060-019-Q1-K1-B3	LIB3060	g22415	BLASTN	978	1e-92	75
5251	1418	LIB36-009-Q1-E1-D2	LIB36	g22396	BLASTN	1128	1e-90	98
5252	1418	LIB189-009-Q1-E1-G7	LIB189	g22407	BLASTN	1107	1e-89	96
5253	1418	LIB83-007-Q1-E1-G12	LIB83	g22396	BLASTN	1151	1e-86	99
5254	1418	LIB36-007-Q1-E1-G7	LIB36	g22396	BLASTN	1136	1e-85	99
5255	1418	LIB3060-004-Q1-K1-C8	LIB3060	g22415	BLASTN	521	1e-82	92

5256	1418	LIB3060-026-Q1-K1-C11	LIB3060	g22407	BLASTN	339	1e-76	81
5257	1418	LIB3060-022-Q1-K1-G9	LIB3060	g22407	BLASTN	845	1e-72	88
5258	1418	LIB189-029-Q1-E1-C4	LIB189	g22407	BLASTN	611	1e-67	93
5259	1418	LIB3060-019-Q1-K1-E3	LIB3060	g22407	BLASTN	389	1e-66	87
5260	1418	LIB36-004-Q1-E1-E2	LIB36	g22407	BLASTN	649	1e-62	83
5261	1418	LIB83-005-Q1-E1-A6	LIB83	g22396	BLASTN	656	1e-45	99
5262	1418	LIB84-026-Q1-E1-F1	LIB84	g22407	BLASTN	337	1e-43	89
5263	1418	LIB84-014-Q1-E1-A8	LIB84	g22396	BLASTN	435	1e-27	100
5264	1418	LIB36-021-Q1-E1-H5	LIB36	g22396	BLASTN	346	1e-19	99
5265	16592	LIB3060-041-Q1-K1-A12	LIB3060	g22415	BLASTN	1550	1e-173	99
5266	16592	LIB3060-007-Q1-K1-C8	LIB3060	g22562	BLASTN	2092	1e-165	98
5267	16592	LIB3060-014-Q1-K1-D4	LIB3060	g22562	BLASTN	2034	1e-160	96
5268	16592	LIB3060-029-Q1-K1-H6	LIB3060	g22562	BLASTN	1998	1e-157	97
5269	16592	LIB3060-011-Q1-K1-G8	LIB3060	g22562	BLASTN	1805	1e-155	96
5270	16592	LIB3060-007-Q1-K1-E2	LIB3060	g22562	BLASTN	1875	1e-155	94
5271	16592	LIB3060-003-Q1-K1-E9	LIB3060	g22415	BLASTN	1266	1e-135	89
5272	16592	LIB3060-026-Q1-K1-H9	LIB3060	g22415	BLASTN	1712	1e-133	91
5273	16592	LIB3060-020-Q1-K1-F11	LIB3060	g22412	BLASTN	699	1e-113	95
5274	201	LIB3067-017-Q1-K1-H10	LIB3067	g3132309	BLASTN	905	1e-98	81
5275	21797	LIB3067-036-Q1-K1-C4	LIB3067	g3132309	BLASTN	993	1e-117	89
5276	26948	LIB3069-056-Q1-K1-C9	LIB3069	g21629	BLASTN	273	1e-15	85
5277	26948	LIB36-004-Q1-E1-E1	LIB36	g21629	BLASTN	273	1e-14	83
5278	30586	LIB3067-044-Q1-K1-F10	LIB3067	g467551	BLASTN	1151	1e-87	79
5279	3591	LIB3059-005-Q1-K1-A6	LIB3059	g429148	BLASTN	2207	1e-174	99
5280	4329	LIB3060-051-Q1-K1-H4	LIB3060	g21629	BLASTN	1872	1e-147	91
5281	4530	LIB3059-014-Q1-K1-E8	LIB3059	g429148	BLASTN	2071	1e-163	98
5282	9226	LIB3069-044-Q1-K1-F2	LIB3069	g169843	BLASTN	1596	1e-123	89

# SOYBEAN PHOSPHOENOLPYRUVATE CARBOXYLASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5283	-700564927	700564927H1	SOYMON002	g218266	BLASTN	522	1e-79	95
5284	-700567858	700567858H1	SOYMON002	g2266946	BLASTN	892	1e-69	83
5285	-700648673	700648673H1	SOYMON003	g467551	BLASTN	1020	1e-106	97
5286	-700659068	700659068H1	SOYMON004	g218266	BLASTN	1095	1e-95	100
5287	-700728930	700728930H1	SOYMON009	g166416	BLASTX	114	1e-12	49
5288	-700739901	700739901H1	SOYMON012	g2266946	BLASTN	868	1e-63	81
5289	-700741179	700741179H1	SOYMON012	g2959439	BLASTX	190	1e-20	88
5290	-700742902	700742902H1	SOYMON012	g147341	BLASTX	71	1e-9	46
5291	-700751669	700751669H1	SOYMON014	g169844	BLASTX	263	1e-29	58
5292	-700753587	700753587H1	SOYMON014	g2266946	BLASTN	750	1e-53	81
5293	-700755512	700755512H1	SOYMON014	g218266	BLASTN	1173	1e-88	99
5294	-700755528	700755528H1	SOYMON014	g218266	BLASTN	623	1e-48	88
5295	-700834546	700834546H1	SOYMON019	g2266946	BLASTN	826	1e-59	85
5296	-700864136	700864136H1	SOYMON016	g2266946	BLASTN	637	1e-44	79
5297	-700876401	700876401H1	SOYMON018	g22560	BLASTN	540	1e-64	84
5298	-700890236	700890236H1	SOYMON024	g467551	BLASTN	491	1e-63	94
5299	-700955462	700955462H1	SOYMON022	g467551	BLASTN	521	1e-74	95
5300	-700959358	700959358H1	SOYMON022	g218266	BLASTN	1245	1e-94	100
5301	-700971291	700971291H1	SOYMON005	g218266	BLASTN	1307	1e-100	99
5302	-700979408	700979408H1	SOYMON009	g2266946	BLASTN	798	1e-70	85
5303	-700987250	700987250H1	SOYMON009	g2266946	BLASTN	656	1e-58	78
5304	-700987503	700987503H1	SOYMON009	g218266	BLASTN	890	1e-65	80
5305	-700991194	700991194H1	SOYMON011	g2266946	BLASTN	600	1e-41	78
5306	-701002203	701002203H1	SOYMON018	g2626748	BLASTN	420	1e-57	94
5307	-701043122	701043122H1	SOYMON029	g467551	BLASTN	823	1e-59	96
5308	-701043454	701043454H1	SOYMON029	g218266	BLASTN	631	1e-75	98
5309	-701046608	701046608H1	SOYMON032	g218266	BLASTN	891	1e-87	95
5310	-701062388	701062388H1	SOYMON033	g2626744	BLASTN	476	1e-40	93
5311	-701119910	701119910H1	SOYMON037	g2626742	BLASTN	630	1e-49	78
5312	-701213104	701213104H1	SOYMON035	g2266946	BLASTN	475	1e-57	78
5313	10663	700732365H1	SOYMON010	g2266946	BLASTN	875	1e-64	82
5314	10663	700981524H1	SOYMON009	g2266946	BLASTN	596	1e-62	80
5315	11125	700663617H1	SOYMON005	g218266	BLASTN	410	1e-38	98
5316	11125	700663717H1	SOYMON005	g218266	BLASTN	410	1e-35	85
5317	11125	700870993H1	SOYMON018	g218266	BLASTN	231	1e-9	96
5318	11227	700686116H1	SOYMON008	g2266946	BLASTN	995	1e-74	85
5319	11227	700944212H1	SOYMON024	g2266946	BLASTN	936	1e-69	85
5320	12325	700985848H1	SOYMON009	g2626742	BLASTN	1275	1e-97	94
5321	12325	701120339H1	SOYMON037	g467551	BLASTN	1210	1e-91	100
5322	12325	701214949H1	SOYMON035	g2626742	BLASTN	1175	1e-89	100
5323	12325	701096990H1	SOYMON028	g467551	BLASTN	1054	1e-78	94
5324	12325	701038039H1	SOYMON029	g467551	BLASTN	666	1e-77	98
5325	12325	701006212H2	SOYMON019	g467551	BLASTN	716	1e-62	95
5326	14728	700730704H1	SOYMON009	g2145426	BLASTX	147	1e-17	54
5327	14728	700685609H1	SOYMON008	g3341490	BLASTX	177	1e-17	43
5328	15298	701041573H1	SOYMON029	g2626742	BLASTN	1325	1e-101	100
5329	15298	701099785H1	SOYMON028	g2626742	BLASTN	1145	1e-100	100
5330	15298	700897382H1	SOYMON027	g2626742	BLASTN	972	1e-81	98
5331	17279	700874273H1	SOYMON018	g218266	BLASTN	980	1e-92	100
5332	17279	700684541H1	SOYMON008	g218266	BLASTN	328	1e-79	98
5333	18846	700836067H1	SOYMON019	g2626746	BLASTN	687	1e-97	99
5334	18846	700567643H1	SOYMON002	g2626746	BLASTN	1082	1e-83	99

5335	21305	700744392H1	SOYMON013	g19535	BLASTN	330	1e-33	78
5336	21305	700747092H1	SOYMON013	g19535	BLASTN	264	1e-28	80
5337	21695	700666285H1	SOYMON005	g218266	BLASTN	1251	1e-95	99
5338	21695	700945580H1	SOYMON024	g218266	BLASTN	1079	1e-81	88
5339	21940	701068565H1	SOYMON034	g218266	BLASTN	1334	1e-102	98
5340	21940	700943287H1	SOYMON024	g218266	BLASTN	945	1e-74	96
5341	22008	701040960H1	SOYMON029	g2626742	BLASTN	1321	1e-101	99
5342	22008	701038869H1	SOYMON029	g2626742	BLASTN	711	1e-66	99
5343	25805	700834887H1	SOYMON019	g2626742	BLASTN	1132	1e-85	95
5344	25805	701127019H1	SOYMON037	g467551	BLASTN	748	1e-80	96
5345	26379	701154209H1	SOYMON031	g2266946	BLASTN	799	1e-57	81
5346	26379	701154248H1	SOYMON031	g2626742	BLASTN	735	1e-52	81
5347	27397	701122563H1	SOYMON037	g2266946	BLASTN	753	1e-53	85
5348	27397	701122647H1	SOYMON037	g2266946	BLASTN	602	1e-41	76
5349	28129	701123443H1	SOYMON037	g1146155	BLASTX	102	1e-14	58
5350	6467	700648723H1	SOYMON003	g1213341	BLASTX	165	1e-19	68
5351	6467	700648341H1	SOYMON003	g1146154	BLASTN	257	1e-12	74
5352	7471	700889346H1	SOYMON024	g2266946	BLASTN	921	1e-67	85
5353	7471	700741422H1	SOYMON012	g2266946	BLASTN	891	1e-65	85
5354	7951	700962862H1	SOYMON022	g467551	BLASTN	1236	1e-94	99
5355	7951	700729127H1	SOYMON009	g467551	BLASTN	665	1e-93	100
5356	7951	700962754H1	SOYMON022	g467551	BLASTN	1127	1e-87	94
5357	9942	701042717H1	SOYMON029	g2626742	BLASTN	1275	1e-97	100
5358	9942	700943121H1	SOYMON024	g467551	BLASTN	1243	1e-94	99
5359	-GM12190	LIB3049-036-Q1-E1-F5	LIB3049	g18463	BLASTN	319	1e-16	69
5360	-GM13015	LIB3049-037-Q1-E1-D7	LIB3049	g18463	BLASTN	248	1e-11	74
5361	-GM13035	LIB3049-037-Q1-E1-A8	LIB3049	g18463	BLASTN	250	1e-11	65
5362	-GM13114	LIB3049-037-Q1-E1-E12	LIB3049	g18463	BLASTN	239	1e-9	63
5363	-GM13510	LIB3049-046-Q1-E1-A2	LIB3049	g2959438	BLASTN	531	1e-33	88
5364	-GM13784	LIB3049-048-Q1-E1-E12	LIB3049	g18463	BLASTN	242	1e-9	62
5365	-GM13839	LIB3049-051-Q1-E1-C6	LIB3049	g18463	BLASTN	230	1e-10	60
5366	-GM14450	LIB3049-056-Q1-E1-D1	LIB3049	g18463	BLASTN	231	1e-8	61
5367	-GM24091	LIB3040-011-Q1-E1-G3	LIB3040	g18463	BLASTN	221	1e-9	66
5368	-GM2515	LIB3028-013-Q1-B1-H1	LIB3028	g18463	BLASTN	242	1e-11	66
5369	-GM6973	LIB3039-025-Q1-E1-C6	LIB3039	g18463	BLASTN	240	1e-11	66
5370	-GM7231	LIB3039-024-Q1-E1-C7	LIB3039	g18463	BLASTN	264	1e-12	65
5371	12325	LIB3056-009-Q1-N1-H12	LIB3056	g467551	BLASTN	1487	1e-123	93



# MAIZE NADP-DEPENDENT MALATE DEHYDROGENASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5372	-700579267	700579267H1	SATMON031	g22367	BLASTN	472	1e-43	88
5373	4577	700098054H1	SATMON009	g22367	BLASTN	835	1e-121	100
5374	4577	700097706H1	SATMON009	g22367	BLASTN	1536	1e-119	98
5375	4577	700097409H1	SATMON009	g22367	BLASTN	1497	1e-116	98
5376	4577	700100389H1	SATMON009	g22367	BLASTN	1431	1e-110	98
5377	4577	700098228H1	SATMON009	g22367	BLASTN	1405	1e-108	93
5378	4577	700042625H1	SATMON004	g22367	BLASTN	1366	1e-105	99
5379	4577	700044532H1	SATMON004	g22367	BLASTN	1366	1e-105	99
5380	4577	700426221H1	SATMONN01	g22367	BLASTN	761	1e-103	98
5381	4577	700045403H1	SATMON004	g22367	BLASTN	1145	1e-103	100
5382	4577	700100550H1	SATMON009	g22367	BLASTN	747	1e-101	97
5383	4577	700439608H1	SATMON026	g22367	BLASTN	1187	1e-100	97
5384	4577	700578318H1	SATMON031	g22367	BLASTN	755	1e-97	98
5385	4577	700084313H1	SATMON011	g22367	BLASTN	589	1e-96	98
5386	4577	700434067H1	SATMONN01	g22367	BLASTN	697	1e-95	98
5387	4577	700578011H1	SATMON031	g22367	BLASTN	1125	1e-93	99
5388	4577	700099962H1	SATMON009	g22367	BLASTN	1231	1e-93	87
5389	4577	700445309H1	SATMON027	g22367	BLASTN	452	1e-92	96
5390	4577	700213872H1	SATMON016	g22367	BLASTN	1181	1e-89	92
5391	4577	700578418H1	SATMON031	g22367	BLASTN	981	1e-85	95
5392	4577	700429351H1	SATMONN01	g22367	BLASTN	624	1e-84	96
5393	4577	700045012H1	SATMON004	g22367	BLASTN	1125	1e-84	94
5394	4577	700197938H1	SATMON016	g22367	BLASTN	1108	1e-83	99
5395	4577	700433880H1	SATMONN01	g22367	BLASTN	755	1e-73	97
5396	4577	700043693H1	SATMON004	g22367	BLASTN	886	1e-73	95
5397	4577	700581629H1	SATMON031	g22367	BLASTN	335	1e-69	91
5398	4577	700422827H1	SATMONN01	g22367	BLASTN	831	1e-69	96
5399	4577	700167037H1	SATMON013	g22367	BLASTN	889	1e-65	94
5400	4577	700438770H1	SATMON026	g22367	BLASTN	666	1e-53	94
5401	4577	700425253H1	SATMONN01	g22367	BLASTN	436	1e-50	95
5402	4577	700423354H1	SATMONN01	g22367	BLASTN	462	1e-50	97
5403	4577	700211538H1	SATMON016	g22367	BLASTN	540	1e-43	100
5404	4577	700097126H1	SATMON009	g22367	BLASTN	504	1e-33	97
5405	4577	700098826H1	SATMON009	g22367	BLASTN	488	1e-31	90
5406	4577	700100862H1	SATMON009	g22367	BLASTN	189	1e-13	92
5407	-L30602059	LIB3060-016-Q1-K1-C12	LIB3060	g22367	BLASTN	838	1e-128	87
5408	4577	LIB36-016-Q2-E2-D10	LIB36	g22367	BLASTN	2081	1e-164	98
5409	4577	LIB3078-033-Q1-K1-F11	LIB3078	g22367	BLASTN	2048	1e-162	93
5410	4577	LIB36-013-Q1-E1-D5	LIB36	g22367	BLASTN	2051	1e-162	97
5411	4577	LIB3060-021-Q1-K1-F9	LIB3060	g22367	BLASTN	1589	1e-156	96
5412	4577	LIB36-015-Q1-E1-A7	LIB36	g22367	BLASTN	1805	1e-153	98
5413	4577	LIB36-002-Q1-E1-D3	LIB36	g22367	BLASTN	1723	1e-149	91
5414	4577	LIB3060-013-Q1-K1-G5	LIB3060	g22367	BLASTN	1836	1e-149	96
5415	4577	LIB3060-013-	LIB3060	g22367	BLASTN	1091	1e-135	95

5416	4577	Q1-K1-G2 LIB36-020- Q1-E1-F1	LIB36	g22367	BLASTN	1400	1e-130	96
5417	4577	LIB3079-013- Q1-K1-G10	LIB3079	g22367	BLASTN	1474	1e-128	98
5418	4577	LIB189-018- Q1-E1-C10	LIB189	g22367	BLASTN	1427	1e-125	93
5419	4577	LIB3078-052- Q1-K1-B9	LIB3078	g22367	BLASTN	1306	1e-114	90

#### SOYBEAN NADP-DEPENDENT MALATE DEHYDROGENASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5420	-701120823	701120823H1	SOYMON037	g397474	BLASTN	410	1e-52	84
5421	13458	700897079H1	SOYMON027	g397474	BLASTN	874	1e-64	83
5422	5228	701139976H1	SOYMON038	g397474	BLASTN	1145	1e-86	92
5423	5228	700738591H1	SOYMON012	g397474	BLASTN	991	1e-73	91

#### MAIZE ASPARTATE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5424	-700028003	700028003H1	SATMON003	g63066	BLASTX	125	1e-10	79
5425	-700072842	700072842H1	SATMON007	g1001121	BLASTX	259	1e-28	50
5426	-700194011	700194011H1	SATMON014	g435456	BLASTN	324	1e-18	73
5427	-700196486	700196486H1	SATMON014	g20599	BLASTX	68	1e-10	74
5428	-700331820	700331820H1	SATMON019	g20600	BLASTN	1192	1e-90	90
5429	-700454550	700454550H1	SATMON029	g435458	BLASTN	198	1e-20	82
5430	-700454567	700454567H1	SATMON029	g435458	BLASTN	333	1e-24	82
5431	-700454642	700454642H1	SATMON029	g435458	BLASTN	269	1e-23	89
5432	-700454849	700454849H1	SATMON029	g435458	BLASTN	318	1e-26	87
5433	-700468560	700468560H1	SATMON025	g3328816	BLASTX	139	1e-19	58
5434	-700476413	700476413H1	SATMON025	g2984217	BLASTX	156	1e-22	52
5435	-700615109	700615109H1	SATMON033	g20598	BLASTN	256	1e-17	81
5436	-701161385	701161385H1	SATMONN04	g435458	BLASTN	523	1e-45	80
5437	10165	700341126H1	SATMON020	g20596	BLASTN	743	1e-71	91
5438	10165	700160220H1	SATMON012	g20596	BLASTN	769	1e-55	92
5439	10165	700158802H1	SATMON012	g20596	BLASTN	617	1e-42	94
5440	10192	700204319H1	SATMON003	g2984217	BLASTX	148	1e-13	55
5441	10329	700095671H1	SATMON008	g20600	BLASTN	816	1e-59	87
5442	10329	700214146H1	SATMON016	g20596	BLASTN	610	1e-42	88
5443	10329	700041823H1	SATMON004	g20596	BLASTN	615	1e-42	78
5444	10329	700094321H1	SATMON008	g20596	BLASTN	559	1e-40	88
5445	1148	700089060H1	SATMON011	g633094	BLASTN	1397	1e-107	92
5446	1148	700044414H1	SATMON004	g633094	BLASTN	1272	1e-97	92
5447	1148	700101429H1	SATMON009	g633094	BLASTN	1221	1e-92	91
5448	1148	700221366H1	SATMON011	g633094	BLASTN	1205	1e-91	94
5449	1148	700101604H1	SATMON009	g633094	BLASTN	1167	1e-88	89
5450	1148	700041864H1	SATMON004	g633094	BLASTN	1159	1e-87	91
5451	1148	700157048H1	SATMON012	g633094	BLASTN	1121	1e-84	93
5452	1148	700581463H1	SATMON031	g633094	BLASTN	1124	1e-84	90
5453	1148	700579938H1	SATMON031	g633094	BLASTN	661	1e-83	91
5454	1148	700432477H1	SATMONN01	g633094	BLASTN	1050	1e-78	90
5455	1148	700154706H1	SATMON007	g633094	BLASTN	997	1e-74	90
5456	1148	700043761H1	SATMON004	g633094	BLASTN	905	1e-66	92

5457	1148	700423679H1	SATMONN01	g633094	BLASTN	555	1e-54	81
5458	1148	700424076H1	SATMONN01	g633094	BLASTN	228	1e-19	87
5459	1148	701166426H1	SATMONN04	g633094	BLASTN	221	1e-16	79
5460	16872	700211160H1	SATMON016	g633094	BLASTN	482	1e-56	88
5461	16872	700043705H1	SATMON004	g633094	BLASTN	293	1e-42	85
5462	16872	700208983H1	SATMON016	g633094	BLASTN	250	1e-15	84
5463	16872	700101375H1	SATMON009	g633094	BLASTN	154	1e-11	87
5464	17829	700581970H1	SATMON031	g1001309	BLASTX	107	1e-11	53
5465	17829	700194282H1	SATMON014	g1001309	BLASTX	107	1e-11	53
5466	18047	700206971H1	SATMON003	g1103380	BLASTX	107	1e-12	53
5467	19241	700472363H1	SATMON025	g20598	BLASTN	1010	1e-81	89
5468	19241	700472263H1	SATMON025	g20598	BLASTN	916	1e-78	89
5469	19241	700806145H1	SATMON036	g20598	BLASTN	947	1e-74	92
5470	319	700076939H1	SATMON007	g20598	BLASTN	1102	1e-83	89
5471	319	700349974H1	SATMON023	g20598	BLASTN	1018	1e-80	84
5472	319	700235923H1	SATMON010	g20598	BLASTN	1017	1e-79	88
5473	319	700206180H1	SATMON003	g20598	BLASTN	838	1e-78	86
5474	319	700476547H1	SATMON025	g20598	BLASTN	794	1e-76	88
5475	319	700258893H1	SATMON017	g20598	BLASTN	897	1e-73	89
5476	319	700612236H1	SATMON022	g20598	BLASTN	820	1e-72	86
5477	319	700806537H1	SATMON036	g20598	BLASTN	949	1e-70	87
5478	319	700450338H1	SATMON028	g20598	BLASTN	912	1e-67	85
5479	319	700806243H1	SATMON036	g20598	BLASTN	782	1e-66	87
5480	319	700263732H1	SATMON017	g435456	BLASTN	662	1e-61	86
5481	319	700806094H1	SATMON036	g20598	BLASTN	375	1e-59	91
5482	319	700152610H1	SATMON007	g20598	BLASTN	806	1e-58	85
5483	319	700614581H1	SATMON033	g20598	BLASTN	729	1e-51	89
5484	319	700349161H1	SATMON023	g20598	BLASTN	270	1e-30	87
5485	319	700805964H1	SATMON036	g20598	BLASTN	463	1e-29	79
5486	319	700450544H1	SATMON028	g20598	BLASTN	280	1e-27	86
5487	319	700618252H1	SATMON033	g20598	BLASTN	407	1e-26	86
5488	319	700615189H1	SATMON033	g20598	BLASTN	309	1e-25	87
5489	319	700264196H1	SATMON017	g20598	BLASTN	412	1e-25	84
5490	4431	700211615H1	SATMON016	g1001309	BLASTX	96	1e-9	32
5491	541	700073508H1	SATMON007	g633094	BLASTN	1388	1e-106	91
5492	541	700098793H1	SATMON009	g633094	BLASTN	1329	1e-101	90
5493	541	700101956H1	SATMON009	g633094	BLASTN	1307	1e-100	89
5494	541	700100132H1	SATMON009	g633094	BLASTN	1314	1e-100	93
5495	541	700799335H1	SATMON036	g633094	BLASTN	1216	1e-92	95
5496	541	700446909H1	SATMON027	g633094	BLASTN	1154	1e-87	91
5497	541	700444305H1	SATMON027	g633094	BLASTN	988	1e-86	97
5498	541	700222187H1	SATMON011	g633094	BLASTN	1116	1e-84	89
5499	541	700093340H1	SATMON008	g633094	BLASTN	1121	1e-84	90
5500	541	700576310H1	SATMON030	g633094	BLASTN	1107	1e-83	91
5501	541	7004						

5511	7402	700456918H1	SATMON029	g20596	BLASTN	968	1e-71	95
5512	7402	700453876H1	SATMON029	g20600	BLASTN	761	1e-54	96
5513	7402	700623616H1	SATMON034	g20596	BLASTN	432	1e-39	96
5514	7402	700454592H1	SATMON029	g20600	BLASTN	380	1e-30	81
5515	7402	700454593H1	SATMON029	g20600	BLASTN	310	1e-28	96
5516	7482	700197666H1	SATMON014	g2621088	BLASTX	145	1e-24	55
5517	7482	700615228H1	SATMON033	g3328816	BLASTX	201	1e-20	61
5518	7482	700030129H1	SATMON003	g3328816	BLASTX	178	1e-17	56
5519	7482	700579227H1	SATMON031	g2621088	BLASTX	132	1e-15	44
5520	786	700476002H1	SATMON025	g20598	BLASTN	1119	1e-90	92
5521	786	700461103H1	SATMON033	g20598	BLASTN	1196	1e-90	91
5522	786	700240702H1	SATMON010	g20598	BLASTN	1174	1e-89	91
5523	786	700470851H1	SATMON025	g20598	BLASTN	1138	1e-86	91
5524	786	700262654H1	SATMON017	g20598	BLASTN	1138	1e-86	91
5525	786	700452647H1	SATMON028	g20598	BLASTN	1115	1e-84	88
5526	786	700194349H1	SATMON014	g20598	BLASTN	1115	1e-84	92
5527	786	700472225H1	SATMON025	g20598	BLASTN	645	1e-82	86
5528	786	700461203H1	SATMON033	g20598	BLASTN	1019	1e-82	90
5529	786	700581588H1	SATMON031	g20598	BLASTN	561	1e-79	90
5530	786	700194330H1	SATMON014	g20598	BLASTN	1043	1e-78	90
5531	786	700194016H1	SATMON014	g20598	BLASTN	1044	1e-78	90
5532	786	700157347H1	SATMON012	g20598	BLASTN	1049	1e-78	90
5533	786	700195805H1	SATMON014	g20598	BLASTN	1049	1e-78	90
5534	786	700160255H1	SATMON012	g20598	BLASTN	1040	1e-77	93
5535	786	700582138H1	SATMON031	g20598	BLASTN	885	1e-75	88
5536	786	700197148H1	SATMON014	g20598	BLASTN	1007	1e-75	90
5537	786	700159366H1	SATMON012	g20598	BLASTN	1016	1e-75	91
5538	786	701184326H1	SATMONN06	g20598	BLASTN	815	1e-72	89
5539	786	700159491H1	SATMON012	g20598	BLASTN	979	1e-72	93
5540	786	700104663H1	SATMON010	g20598	BLASTN	966	1e-71	86
5541	786	700195003H1	SATMON014	g20598	BLASTN	779	1e-69	86
5542	786	700218254H1	SATMON016	g20598	BLASTN	942	1e-69	89
5543	786	700802451H1	SATMON036	g20598	BLASTN	581	1e-68	90
5544	786	700157772H1	SATMON012	g20598	BLASTN	887	1e-65	90
5545	786	700473425H1	SATMON025	g20598	BLASTN	466	1e-64	85
5546	786	700800486H1	SATMON036	g20598	BLASTN	868	1e-63	91
5547	786	700185039H1	SATMON014	g20598	BLASTN	859	1e-62	86
5548	786	700800057H1	SATMON036	g20598	BLASTN	567	1e-59	85
5549	786	700451832H1	SATMON028	g20598	BLASTN	501	1e-58	88
5550	786	700799994H1	SATMON036	g20598	BLASTN	570	1e-55	91
5551	786	700801486H1	SATMON036	g20598	BLASTN	750	1e-53	91
5552	786	700802086H1	SATMON036	g20598	BLASTN	459	1e-51	89
5553	786	700477105H1	SATMON025	g20598	BLASTN	708	1e-50	90
5554	786	700260426H1	SATMON017	g20598	BLASTN	702	1e-49	84
5555	786	700799811H1	SATMON036	g20598	BLASTN	409	1e-48	84
5556	786	700427005H1	SATMONN01	g20598	BLASTN	691	1e-48	89
5557	786	700803487H1	SATMON036	g20598	BLASTN	423	1e-46	83
5558	786	700262695H1	SATMON017	g20598	BLASTN	367	1e-43	89
5559	786	700471602H1	SATMON025	g20598	BLASTN	601	1e-41	90
5560	786	701185813H2	SATMONN06	g20598	BLASTN	320	1e-39	83
5561	786	700196744H1	SATMON014	g20598	BLASTN	490	1e-32	92
5562	786	701184204H1	SATMONN06	g20598	BLASTN	247	1e-10	78
5563	786	700622453H1	SATMON034	g20598	BLASTN	230	1e-8	79
5564	786	700618768H1	SATMON034	g20598	BLASTN	230	1e-8	79

5565	-L30591931	LIB3059-009-Q1-K1-C12	LIB3059	g20596	BLASTN	1989	1e-157	95
5566	-L30593805	LIB3059-022-Q1-K1-H6	LIB3059	g20596	BLASTN	377	1e-56	79
5567	-L30596704	LIB3059-055-Q1-K1-E5	LIB3059	g20596	BLASTN	733	1e-52	89
5568	-L30624957	LIB3062-040-Q1-K1-H1	LIB3062	g633095	BLASTX	112	1e-27	56
5569	-L30671766	LIB3067-014-Q1-K1-B8	LIB3067	g20596	BLASTN	1132	1e-122	86
5570	-L30693715	LIB3069-012-Q1-K1-F3	LIB3069	g142538	BLASTX	98	1e-24	47
5571	10329	LIB3079-007-Q1-K1-B3	LIB3079	g20596	BLASTN	1201	1e-97	87
5572	10329	LIB143-052-Q1-E1-E4	LIB143	g20596	BLASTN	751	1e-53	86
5573	1148	LIB3078-040-Q1-K1-H1	LIB3078	g633094	BLASTN	1675	1e-130	87
5574	1148	LIB3062-040-Q1-K1-H3	LIB3062	g633094	BLASTN	1310	1e-100	88
5575	1148	LIB143-054-Q1-E1-F1	LIB143	g633094	BLASTN	1234	1e-94	88
5576	1148	LIB83-001-Q1-E1-A10	LIB83	g633094	BLASTN	1030	1e-77	81
5577	16872	LIB36-018-Q1-E1-D12	LIB36	g633094	BLASTN	542	1e-69	85
5578	25099	LIB3059-012-Q1-K1-G3	LIB3059	g1001309	BLASTX	130	1e-36	38
5579	319	LIB143-022-Q1-E1-G3	LIB143	g20598	BLASTN	1698	1e-135	89
5580	319	LIB143-048-Q1-E1-G12	LIB143	g20598	BLASTN	1562	1e-126	87
5581	319	LIB143-001-Q1-E1-H6	LIB143	g20598	BLASTN	1462	1e-113	90
5582	319	LIB143-002-Q1-E1-H2	LIB143	g20598	BLASTN	484	1e-66	88
5583	32047	LIB148-034-Q1-E1-F3	LIB148	g435456	BLASTN	262	1e-12	68
5584	32047	LIB148-032-Q1-E1-H8	LIB148	g435456	BLASTN	255	1e-11	71
5585	541	LIB3062-033-Q1-K1-G2	LIB3062	g633094	BLASTN	1706	1e-133	90
5586	541	LIB3062-033-Q1-K1-G3	LIB3062	g633094	BLASTN	1123	1e-94	84
5587	541	LIB3060-005-Q1-K1-C1	LIB3060	g633094	BLASTN	1061	1e-90	84
5588	7402	LIB3059-004-Q1-K1-F4	LIB3059	g20596	BLASTN	1461	1e-142	92
5589	786	LIB3061-042-Q1-K1-E8	LIB3061	g20598	BLASTN	1811	1e-142	88
5590	786	LIB143-040-Q1-E1-D11	LIB143	g20598	BLASTN	1462	1e-113	92
5591	786	LIB143-030-Q1-E1-D9	LIB143	g20598	BLASTN	1141	1e-101	90

5592	786	LIB3068-035-Q1-K1-A4	LIB3068	g20598	BLASTN	533	1e-99	78
5593	786	LIB143-017-Q1-E1-C8	LIB143	g20598	BLASTN	678	1e-92	82
5594	786	LIB143-030-Q1-E1-D11	LIB143	g20598	BLASTN	1165	1e-88	86
5595	786	LIB3061-048-Q1-K1-D7	LIB3061	g20598	BLASTN	299	1e-15	78
5596	786	LIB3059-056-Q1-K1-B1	LIB3059	g20598	BLASTN	283	1e-12	74

#### MAIZE PUTATIVE ASPARTATE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5597	-700201453	700201453H1	SATMON003	g1049345	BLASTX	178	1e-17	64
5598	23836	700243862H1	SATMON010	g1778518	BLASTX	133	1e-11	49
5599	23836	701169557H1	SATMONN05	g1778518	BLASTX	126	1e-10	54
5600	7482	LIB3059-049-Q1-K1-E5	LIB3059	g2621088	BLASTX	138	1e-48	51

#### SOYBEAN ASPARTATE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5601	-700668054	700668054H1	SOYMON006	g3328816	BLASTX	172	1e-16	53
5602	-700685655	700685655H1	SOYMON008	g387106	BLASTX	165	1e-15	62
5603	-700729138	700729138H1	SOYMON009	g2621088	BLASTX	136	1e-17	47
5604	-700734818	700734818H1	SOYMON010	g3201622	BLASTX	234	1e-25	54
5605	-700787411	700787411H2	SOYMON011	g20598	BLASTN	908	1e-66	90
5606	-700868646	700868646H1	SOYMON016	g435458	BLASTN	513	1e-33	75
5607	-700874369	700874369H1	SOYMON018	g2654093	BLASTN	808	1e-63	90
5608	-700974412	700974412H1	SOYMON005	g169914	BLASTN	249	1e-11	83
5609	-701009475	701009475H1	SOYMON019	g1001309	BLASTX	111	1e-15	49
5610	-701050301	701050301H1	SOYMON032	g169914	BLASTN	263	1e-11	75
5611	-701061267	701061267H1	SOYMON033	g169914	BLASTN	235	1e-35	88
5612	-701129551	701129551H1	SOYMON037	g169914	BLASTN	1232	1e-93	93
5613	13413	700904367H1	SOYMON022	g1001121	BLASTX	231	1e-24	52
5614	13413	700895714H1	SOYMON027	g2266762	BLASTX	175	1e-22	49
5615	13413	700727795H1	SOYMON009	g1001121	BLASTX	190	1e-19	48
5616	13503	700974712H1	SOYMON005	g169914	BLASTN	1358	1e-104	99
5617	13503	700895483H1	SOYMON027	g169914	BLASTN	1236	1e-94	97
5618	13503	700846207H1	SOYMON021	g169914	BLASTN	1136	1e-85	94
5619	14358	700909477H1	SOYMON022	g710595	BLASTN	1309	1e-100	98
5620	14358	700732673H1	SOYMON010	g710595	BLASTN	1296	1e-99	98
5621	14358	700890192H1	SOYMON024	g710595	BLASTN	913	1e-83	98
5622	14358	700727008H1	SOYMON009	g710595	BLASTN	553	1e-55	99
5623	15432	700567458H1	SOYMON002	g1001309	BLASTX	115	1e-8	31
5624	15529	701045375H1	SOYMON032	g3201622	BLASTX	189	1e-19	55
5625	15529	700567374H1	SOYMON002	g3201622	BLASTX	186	1e-18	55
5626	15529	701102885H1	SOYMON028	g3201622	BLASTX	172	1e-16	56
5627	15529	701213187H1	SOYMON035	g3201622	BLASTX	174	1e-16	55
5628	15529	701055675H1	SOYMON032	g3201622	BLASTX	166	1e-15	60
5629	15529	701052631H1	SOYMON032	g3201622	BLASTX	159	1e-14	53
5630	15529	701213639H1	SOYMON035	g3201622	BLASTX	110	1e-13	59
5631	1566	700651242H1	SOYMON003	g2654093	BLASTN	1433	1e-146	98

5632	1566	700661083H1	SOYMON005	g2654093	BLASTN	898	1e-102	95
5633	1566	700668434H1	SOYMON006	g2654093	BLASTN	1289	1e-98	99
5634	1566	700677640H1	SOYMON007	g2654093	BLASTN	758	1e-97	99
5635	1566	700655909H1	SOYMON004	g2654093	BLASTN	730	1e-95	100
5636	1566	700660728H1	SOYMON005	g2654093	BLASTN	634	1e-81	90
5637	1566	700807523H1	SOYMON016	g2654093	BLASTN	478	1e-31	87
5638	16634	700660070H1	SOYMON004	g2621088	BLASTX	111	1e-20	54
5639	16634	700746670H1	SOYMON013	g2621088	BLASTX	118	1e-18	53
5640	1703	700749933H1	SOYMON013	g2654093	BLASTN	1385	1e-106	100
5641	1703	700793749H1	SOYMON017	g2654093	BLASTN	1370	1e-105	100
5642	1703	701127031H1	SOYMON037	g2654093	BLASTN	716	1e-94	96
5643	1703	700997259H1	SOYMON018	g2654093	BLASTN	1089	1e-81	97
5644	1703	700670783H1	SOYMON006	g2654093	BLASTN	767	1e-79	93
5645	25132	700678487H1	SOYMON007	g2654093	BLASTN	1175	1e-104	98
5646	25132	701049020H1	SOYMON032	g2654093	BLASTN	1260	1e-96	100
5647	25542	701151325H1	SOYMON031	g1001309	BLASTX	96	1e-15	51
5648	25542	700964436H1	SOYMON022	g1001309	BLASTX	107	1e-13	51
5649	26671	701106241H1	SOYMON036	g1001309	BLASTX	121	1e-9	39
5650	26671	701149504H1	SOYMON031	g1001309	BLASTX	122	1e-9	36
5651	27066	700605347H2	SOYMON004	g169914	BLASTN	1147	1e-104	99
5652	27066	701053078H1	SOYMON032	g169914	BLASTN	833	1e-87	96
5653	6297	700971234H1	SOYMON005	g169914	BLASTN	1303	1e-99	99
5654	6297	701205146H1	SOYMON035	g169914	BLASTN	1269	1e-96	94
5655	6297	701137753H1	SOYMON038	g169914	BLASTN	335	1e-85	93
5656	6297	700741154H1	SOYMON012	g169914	BLASTN	1135	1e-85	100
5657	6297	700954813H1	SOYMON022	g169914	BLASTN	1095	1e-84	100
5658	6297	701000832H1	SOYMON018	g169914	BLASTN	410	1e-83	95
5659	6297	701039262H1	SOYMON029	g169914	BLASTN	650	1e-82	97
5660	6297	701108365H1	SOYMON036	g169914	BLASTN	1032	1e-80	97
5661	6297	700953963H1	SOYMON022	g169914	BLASTN	1058	1e-79	92
5662	6297	700971364H1	SOYMON005	g169914	BLASTN	865	1e-63	95
5663	6297	701002832H1	SOYMON019	g169914	BLASTN	599	1e-62	90
5664	6297	700650013H1	SOYMON003	g169914	BLASTN	686	1e-61	88
5665	6297	701139166H1	SOYMON038	g169914	BLASTN	632	1e-43	83
5666	6297	701055975H1	SOYMON032	g169914	BLASTN	611	1e-42	99
5667	6297	701131513H1	SOYMON038	g169914	BLASTN	600	1e-41	96
5668	6297	701065138H1	SOYMON034	g169914	BLASTN	432	1e-38	89
5669	6297	701010254H2	SOYMON019	g169914	BLASTN	427	1e-36	88
5670	7549	700666429H1	SOYMON005	g169914	BLASTN	1249	1e-95	96
5671	7549	701001911H1	SOYMON018	g169914	BLASTN	819	1e-59	98
5672	7585	701127651H1	SOYMON037	g2654093	BLASTN	1360	1e-104	100
5673	7585	700668614H1	SOYMON006	g2654093	BLASTN	1341	1e-102	99
5674	7585	701054030H1	SOYMON032	g2654093	BLASTN	1341	1e-102	

5686	7585	700560909H1	SOYMON001	g2654093	BLASTN	1119	1e-84	93
5687	7585	700895972H1	SOYMON027	g2654093	BLASTN	1105	1e-83	100
5688	7585	700663309H1	SOYMON005	g2654093	BLASTN	888	1e-82	95
5689	7585	700787774H2	SOYMON011	g2654093	BLASTN	943	1e-82	96
5690	7585	701069589H1	SOYMON034	g2654093	BLASTN	539	1e-81	93
5691	7585	700663096H1	SOYMON005	g2654093	BLASTN	498	1e-80	95
5692	7585	700836390H1	SOYMON020	g2654093	BLASTN	898	1e-80	95
5693	7585	700967858H1	SOYMON033	g2654093	BLASTN	978	1e-80	92
5694	7585	701101575H1	SOYMON028	g2654093	BLASTN	1032	1e-80	97
5695	7585	700750565H1	SOYMON014	g2654093	BLASTN	812	1e-79	95
5696	7585	701064276H1	SOYMON034	g2654093	BLASTN	820	1e-75	90
5697	7585	700995223H1	SOYMON011	g2654093	BLASTN	765	1e-68	89
5698	7585	700756072H1	SOYMON014	g2654093	BLASTN	899	1e-66	93
5699	7585	701147945H1	SOYMON031	g2654093	BLASTN	648	1e-64	95
5700	7585	700888603H1	SOYMON024	g2654093	BLASTN	865	1e-63	96
5701	9138	700562918H1	SOYMON002	g152149	BLASTX	195	1e-26	61
5702	9138	700654444H1	SOYMON004	g152149	BLASTX	191	1e-24	60
5703	9138	701037102H1	SOYMON029	g152149	BLASTX	123	1e-16	53
5704	-GM17331	LIB3055-010-Q1-N1-G4	LIB3055	g169914	BLASTN	456	1e-27	85
5705	-GM25144	LIB3040-027-Q1-E1-F2	LIB3040	g2654093	BLASTN	526	1e-65	85
5706	-GM41298	LIB3051-109-Q1-K1-F6	LIB3051	g2654093	BLASTN	207	1e-29	83
5707	14358	LIB3051-106-Q1-K1-G8	LIB3051	g710595	BLASTN	2246	1e-178	99
5708	25132	LIB3051-063-Q1-K1-D12	LIB3051	g2654093	BLASTN	1347	1e-103	96
5709	3196	LIB3065-006-Q1-N1-B10	LIB3065	g1778518	BLASTX	170	1e-32	50
5710	32509	LIB3056-012-Q1-N1-C3	LIB3056	g2648397	BLASTX	152	1e-29	43
5711	6297	LIB3055-010-Q1-N1-G6	LIB3055	g169914	BLASTN	1721	1e-134	99
5712	6297	LIB3055-010-Q1-N1-G7	LIB3055	g169914	BLASTN	1246	1e-123	97
5713	6297	LIB3055-010-Q1-N1-G8	LIB3055	g169914	BLASTN	1120	1e-84	93
5714	6297	LIB3049-021-Q1-E1-C8	LIB3049	g169914	BLASTN	864	1e-63	91
5715	7585	LIB3051-105-Q1-K1-F8	LIB3051	g2654093	BLASTN	2108	1e-167	99
5716	7585	LIB3028-010-Q1-B1-C7	LIB3028	g2654093	BLASTN	1973	1e-158	97
5717	7585	LIB3030-001-Q1-B1-B7	LIB3030	g2654093	BLASTN	1117	1e-138	95
5718	7585	LIB3051-040-Q1-K1-D4	LIB3051	g2654093	BLASTN	1166	1e-116	94
5719	9138	LIB3065-001-Q1-N1-G1	LIB3065	g152149	BLASTX	168	1e-38	52



# SOYBEAN PUTATIVE ASPARTATE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5720	9138	700830720H1	SOYMON019	g3257794	BLASTX	186	1e-27	58
5721	9138	701100721H1	SOYMON028	g3257794	BLASTX	206	1e-23	56
5722	9138	700958391H1	SOYMON022	g3257794	BLASTX	217	1e-23	60
5723	9138	701119543H1	SOYMON037	g3257794	BLASTX	152	1e-13	58
5724	-700669394	700669394H1	SOYMON006	g1778518	BLASTX	75	1e-9	50
5725	3196	700753821H1	SOYMON014	g1778518	BLASTX	117	1e-9	59
5726	-700999272	700999272H1	SOYMON018	g1326254	BLASTX	153	1e-15	57
5727	32509	LIB3055-011-Q1-N1-G1	LIB3055	g1778518	BLASTX	124	1e-27	35

# MAIZE ALANINE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5728	-700049393	700049393H1	SATMON003	g296204	BLASTX	143	1e-12	100
5729	-700104304	700104304H1	SATMON010	g1353351	BLASTN	655	1e-45	70
5730	-700172189	700172189H1	SATMON013	g1353352	BLASTX	211	1e-22	70
5731	-700222553	700222553H1	SATMON011	g1353352	BLASTX	292	1e-33	54
5732	-700257069	700257069H1	SATMON017	g469147	BLASTN	610	1e-42	70
5733	-700264090	700264090H1	SATMON017	g296203	BLASTN	798	1e-57	77
5734	-700264413	700264413H1	SATMON017	g296204	BLASTX	319	1e-37	59
5735	-700457290	700457290H1	SATMON029	g296203	BLASTN	640	1e-44	70
5736	-700461128	700461128H1	SATMON033	g469147	BLASTN	482	1e-31	65
5737	-700461228	700461228H1	SATMON033	g296204	BLASTX	120	1e-19	61
5738	-700579019	700579019H1	SATMON031	g1353352	BLASTX	149	1e-16	39
5739	-700584206	700584206H1	SATMON031	g1353352	BLASTX	175	1e-17	62
5740	-700617436	700617436H1	SATMON033	g296204	BLASTX	206	1e-24	51
5741	-700624223	700624223H1	SATMON034	g1353351	BLASTN	476	1e-29	72
5742	-701164032	701164032H1	SATMONN04	g296204	BLASTX	85	1e-11	65
5743	-701166826	701166826H1	SATMONN04	g296203	BLASTN	219	1e-12	84
5744	15087	700801716H1	SATMON036	g296203	BLASTN	434	1e-25	91
5745	15087	700806781H1	SATMON036	g469147	BLASTN	198	1e-11	87
5746	15418	700102926H1	SATMON010	g1353351	BLASTN	550	1e-35	65
5747	15418	700423101H1	SATMONN01	g1353351	BLASTN	475	1e-29	66
5748	22920	701172883H2	SATMONN05	g469147	BLASTN	778	1e-56	77
5749	22920	701172884H2	SATMONN05	g469147	BLASTN	460	1e-51	77
5750	2698	700099203H1	SATMON009	g1353352	BLASTX	192	1e-18	82
5751	29667	700210632H1	SATMON016	g1353352	BLASTX	260	1e-28	57
5752	31650	700580511H1	SATMON031	g1353352	BLASTX	192	1e-35	68
5753	3823	700217635H1	SATMON016	g296203	BLASTN	650	1e-45	76
5754	3823	700349242H1	SATMON023	g296203	BLASTN	524	1e-34	76
5755	414	700473110H1	SATMON025	g296204	BLASTX	204	1e-35	57
5756	414	700264510H1	SATMON017	g469147	BLASTN	456	1e-27	60
5757	414	700262355H1	SATMON017	g469148	BLASTX	241	1e-26	55
5758	414	700263001H1	SATMON017	g469148	BLASTX	230	1e-24	56
5759	414	700474691H1	SATMON025	g296204	BLASTX	179	1e-17	44
5760	414	700615134H1	SATMON033	g469148	BLASTX	127	1e-10	62
5761	6080	700218182H1	SATMON016	g296203	BLASTN	684	1e-48	74
5762	6080	700239054H1	SATMON010	g296203	BLASTN	649	1e-45	74
5763	6080	700207743H1	SATMON016	g296203	BLASTN	592	1e-40	74
5764	6080	700049234H1	SATMON003	g296204	BLASTX	144	1e-12	64
5765	8847	700257223H1	SATMON017	g296204	BLASTX	218	1e-23	54
5766	8847	700267629H1	SATMON017	g296204	BLASTX	184	1e-18	50

5767	8847	700267912H1	SATMON017	g296204	BLASTX	184	1e-18	50
5768	8847	700265819H1	SATMON017	g296204	BLASTX	136	1e-11	43
5769	923	700047471H1	SATMON003	g296203	BLASTN	1211	1e-103	92
5770	923	700446631H1	SATMON027	g296203	BLASTN	766	1e-102	92
5771	923	700263484H1	SATMON017	g296203	BLASTN	1332	1e-102	94
5772	923	700076095H1	SATMON007	g296203	BLASTN	1284	1e-98	93
5773	923	700042264H1	SATMON004	g296203	BLASTN	1267	1e-96	93
5774	923	700041605H1	SATMON004	g296203	BLASTN	1245	1e-94	92
5775	923	700258238H1	SATMON017	g296203	BLASTN	933	1e-93	89
5776	923	700620967H1	SATMON034	g296203	BLASTN	1011	1e-92	91
5777	923	700046079H1	SATMON004	g296203	BLASTN	1211	1e-92	94
5778	923	700073909H1	SATMON007	g296203	BLASTN	1203	1e-91	91
5779	923	701179662H1	SATMONN05	g296203	BLASTN	1194	1e-90	93
5780	923	700045425H1	SATMON004	g296203	BLASTN	1196	1e-90	92
5781	923	700043325H1	SATMON004	g296203	BLASTN	1178	1e-89	93
5782	923	700042080H1	SATMON004	g296203	BLASTN	1061	1e-86	92
5783	923	700799695H1	SATMON036	g296203	BLASTN	1139	1e-86	92
5784	923	700347121H1	SATMON021	g296203	BLASTN	1017	1e-85	88
5785	923	700194649H1	SATMON014	g296203	BLASTN	1129	1e-85	91
5786	923	700803015H1	SATMON036	g296203	BLASTN	959	1e-84	91
5787	923	700046202H1	SATMON004	g296203	BLASTN	1118	1e-84	94
5788	923	700621382H1	SATMON034	g296203	BLASTN	648	1e-83	92
5789	923	700194809H1	SATMON014	g296203	BLASTN	1083	1e-81	94
5790	923	700194576H1	SATMON014	g296203	BLASTN	1089	1e-81	92
5791	923	700045006H1	SATMON004	g296203	BLASTN	1076	1e-80	91
5792	923	700195835H1	SATMON014	g296203	BLASTN	1057	1e-79	91
5793	923	700194814H1	SATMON014	g296203	BLASTN	1058	1e-79	92
5794	923	700046245H1	SATMON004	g296203	BLASTN	1046	1e-78	94
5795	923	700161109H1	SATMON012	g296203	BLASTN	1047	1e-78	94
5796	923	700194345H1	SATMON014	g296203	BLASTN	1037	1e-77	94
5797	923	700472892H1	SATMON025	g296203	BLASTN	505	1e-76	88
5798	923	700617757H1	SATMON033	g296203	BLASTN	863	1e-76	90
5799	923	700805426H1	SATMON036	g296203	BLASTN	523	1e-74	93
5800	923	700801191H1	SATMON036	g296203	BLASTN	724	1e-74	90
5801	923	700472860H1	SATMON025	g296203	BLASTN	876	1e-74	86
5802	923	700100107H1	SATMON009	g296203	BLASTN	999	1e-74	88
5803	923	700465264H1	SATMON025	g296203	BLASTN	784	1e-72	92
5804	923	700455079H1	SATMON029	g296203	BLASTN	930	1e-72	89
5805	923	700620492H1	SATMON034	g296203	BLASTN	718	1e-71	92
5806	923	700801419H1	SATMON036	g296203	BLASTN	909	1e-71	92
5807	923	700155082H1	SATMON007	g296203	BLASTN	949	1e-70	93
5808	923	700045844H1	SATMON004	g296203	BLASTN	808	1e-69	90
5809	923	700477823H1	SATMON025	g296203	BLASTN	922	1e-68	88
5810	923	700475452H1	SATMON025	g296203	BLASTN	824	1e-65	91
5811	923	700802280H1	SATMON036	g296203	BLASTN	874	1e-64	92
5812	923	700156653H1	SATMON012	g296203	BLASTN	780	1e-63	87
5813	923	700444754H1	SATMON027	g296203	BLASTN	831	1e-60	89
5814	923	700099483H1	SATMON009	g296203	BLASTN	724	1e-59	88
5815	923	700101871H1	SATMON009	g296203	BLASTN	821	1e-59	91
5816	923	700076559H1	SATMON007	g296203	BLASTN	765	1e-57	89
5817	923	700442606H1	SATMON026	g296203	BLASTN	791	1e-57	91
5818	923	700800871H1	SATMON036	g296203	BLASTN	494	1e-56	86
5819	923	700197582H1	SATMON014	g296203	BLASTN	786	1e-56	90
5820	923	700100451H1	SATMON009	g296203	BLASTN	476	1e-54	90

5821	923	700405018H1	SATMON027	g296203	BLASTN	597	1e-54	86
5822	923	700099885H1	SATMON009	g296203	BLASTN	653	1e-53	91
5823	923	700043273H1	SATMON004	g296203	BLASTN	721	1e-51	90
5824	923	700476434H1	SATMON025	g296203	BLASTN	449	1e-47	91
5825	923	700438820H1	SATMON026	g296203	BLASTN	671	1e-47	89
5826	923	700428681H1	SATMONN01	g296203	BLASTN	673	1e-47	91
5827	923	700042259H1	SATMON004	g296203	BLASTN	675	1e-47	93
5828	923	700801436H1	SATMON036	g296203	BLASTN	677	1e-47	86
5829	923	700257814H1	SATMON017	g296203	BLASTN	647	1e-45	85
5830	923	700044879H1	SATMON004	g296203	BLASTN	648	1e-45	9
5831	923	700207027H1	SATMON003	g296203	BLASTN	595	1e-42	87
5832	923	700257265H1	SATMON017	g296203	BLASTN	610	1e-42	87
5833	923	700571949H1	SATMON030	g296203	BLASTN	576	1e-39	91
5834	923	701166609H1	SATMONN04	g296203	BLASTN	514	1e-38	83
5835	923	701182932H1	SATMONN06	g296203	BLASTN	383	1e-37	88
5836	923	700281788H1	SATMON020	g296203	BLASTN	398	1e-37	88
5837	923	700151478H1	SATMON007	g296203	BLASTN	554	1e-37	89
5838	923	700423955H1	SATMONN01	g296203	BLASTN	539	1e-36	85
5839	923	700472592H1	SATMON025	g296203	BLASTN	291	1e-34	87
5840	923	700621067H2	SATMON034	g296203	BLASTN	480	1e-31	84
5841	923	700621082H2	SATMON034	g296203	BLASTN	457	1e-29	90
5842	923	700426976H1	SATMONN01	g296203	BLASTN	431	1e-27	93
5843	923	700098538H1	SATMON009	g296204	BLASTX	117	1e-9	69
5844	9316	700263427H1	SATMON017	g1353352	BLASTX	318	1e-36	63
5845	9316	700222070H1	SATMON011	g1353352	BLASTX	296	1e-33	61
5846	9316	700085696H1	SATMON011	g1353352	BLASTX	259	1e-28	67
5847	-L30601398	LIB3060-001-Q1-K2-F11	LIB3060	g296203	BLASTN	610	1e-67	88
5848	-L30603921	LIB3060-042-Q1-K1-E6	LIB3060	g296203	BLASTN	740	1e-63	83
5849	-L30672268	LIB3067-007-Q1-K1-H12	LIB3067	g296203	BLASTN	601	1e-41	85
5850	-L30695453	LIB3069-036-Q1-K1-C10	LIB3069	g296203	BLASTN	868	1e-63	75
5851	-L832403	LIB83-005-Q1-E1-A7	LIB83	g469148	BLASTX	210	1e-37	81
5852	29667	LIB3060-015-Q1-K1-B3	LIB3060	g1353351	BLASTN	631	1e-42	61
5853	31650	LIB148-034-Q1-E1-A6	LIB148	g1353352	BLASTX	127	1e-53	63
5854	923	LIB3067-040-Q1-K1-B11	LIB3067	g296203	BLASTN	1949	1e-153	94
5855	923	LIB3060-017-Q1-K1-F12	LIB3060	g296203	BLASTN	1832	1e-143	92
5856	923	LIB143-053-Q1-E1-G9	LIB143	g296203	BLASTN	1814	1e-142	91
5857	923	LIB148-002-Q1-E1-B9	LIB148	g296203	BLASTN	1821	1e-142	94
5858	923	LIB36-012-Q1-E1-B11	LIB36	g296203	BLASTN	1766	1e-140	92
5859	923	LIB84-004-Q1-E1-F6	LIB84	g296203	BLASTN	1797	1e-140	91
5860	923	LIB3066-019-Q1-K1-E9	LIB3066	g296203	BLASTN	1520	1e-139	94

5861	923	LIB3059-045-Q1-K1-G1	LIB3059	g296203	BLASTN	1777	1e-139	92
5862	923	LIB3059-014-Q1-K1-H7	LIB3059	g296203	BLASTN	1785	1e-139	91
5863	923	LIB3060-044-Q1-K1-E2	LIB3060	g296203	BLASTN	1007	1e-136	92
5864	923	LIB3060-012-Q1-K1-C8	LIB3060	g296203	BLASTN	1662	1e-134	91
5865	923	LIB189-019-Q1-E1-D11	LIB189	g296203	BLASTN	1642	1e-131	92
5866	923	LIB3059-014-Q1-K1-A8	LIB3059	g296203	BLASTN	1232	1e-129	88
5867	923	LIB143-053-Q1-E1-G10	LIB143	g296203	BLASTN	1377	1e-129	90
5868	923	LIB3059-006-Q1-K1-H5	LIB3059	g296203	BLASTN	1532	1e-124	88
5869	923	LIB3060-023-Q1-K1-E6	LIB3060	g296203	BLASTN	1176	1e-122	85
5870	923	LIB36-017-Q1-E1-D3	LIB36	g296203	BLASTN	1545	1e-119	91
5871	923	LIB3060-023-Q1-K1-E7	LIB3060	g296203	BLASTN	1418	1e-109	79
5872	923	LIB3060-036-Q1-K1-D2	LIB3060	g296203	BLASTN	1410	1e-108	92
5873	923	LIB3060-002-Q1-K2-C11	LIB3060	g296203	BLASTN	1400	1e-107	91
5874	923	LIB36-013-Q1-E1-C3	LIB36	g296203	BLASTN	1202	1e-100	87
5875	923	LIB3079-021-Q1-K1-D8	LIB3079	g296203	BLASTN	1236	1e-100	90
5876	923	LIB3060-051-Q1-K1-B8	LIB3060	g296203	BLASTN	1281	1e-97	88
5877	923	LIB3059-048-Q1-K1-A4	LIB3059	g296203	BLASTN	1224	1e-93	94
5878	923	LIB3060-043-Q1-K1-G9	LIB3060	g296203	BLASTN	816	1e-90	92
5879	923	LIB3060-034-Q1-K1-A5	LIB3060	g296203	BLASTN	816	1e-87	88
5880	923	LIB3060-042-Q1-K1-E4	LIB3060	g296203	BLASTN	1126	1e-85	91
5881	923	LIB3060-011-Q1-K1-A9	LIB3060	g296203	BLASTN	790	1e-78	86
5882	923	LIB189-033-Q1-E1-F2	LIB189	g296203	BLASTN	566	1e-74	83
5883	923	LIB3061-041-Q1-K1-B2	LIB3061	g296203	BLASTN	809	1e-68	89
5884	923	LIB3060-030-Q1-K1-E1	LIB3060	g296203	BLASTN	472	1e-65	73
5885	923	LIB3060-004-Q1-K1-A8	LIB3060	g296203	BLASTN	407	1e-38	78
5886	9316	LIB3062-014-Q1-K1-A12	LIB3062	g1353352	BLASTX	448	1e-71	60
5887	9316	LIB3060-041-Q1-K1-C8	LIB3060	g1353352	BLASTX	393	1e-68	58

5888	9316	LIB84-028- Q1-E1-H9	LIB84	g1353352	BLASTX	202	1e-61	61
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# SOYBEAN ALANINE AMINOTRANSFERASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
5889	-700743719	700743719H1	SOYMON012	g1353352	BLASTX	78	1e-8	61
5890	-700959696	700959696H1	SOYMON022	g296204	BLASTX	195	1e-20	79
5891	-700996510	700996510H1	SOYMON018	g296204	BLASTX	187	1e-18	71
5892	-701069323	701069323H1	SOYMON034	g296204	BLASTX	116	1e-21	63
5893	10017	700605618H2	SOYMON005	g296203	BLASTN	496	1e-32	73
5894	10017	700682253H1	SOYMON008	g296204	BLASTX	143	1e-16	71
5895	10017	700990421H1	SOYMON011	g296204	BLASTX	160	1e-15	69
5896	10017	700747761H1	SOYMON013	g296204	BLASTX	164	1e-15	70
5897	10017	701038703H1	SOYMON029	g296204	BLASTX	164	1e-15	70
5898	10017	700975277H1	SOYMON009	g296204	BLASTX	140	1e-14	67
5899	10017	700984821H1	SOYMON009	g296204	BLASTX	155	1e-14	69
5900	10017	700756842H1	SOYMON014	g296204	BLASTX	139	1e-12	68
5901	10017	700746942H1	SOYMON013	g469147	BLASTN	241	1e-9	76
5902	10118	701120663H1	SOYMON037	g296204	BLASTX	350	1e-41	85
5903	10118	701049525H1	SOYMON032	g296204	BLASTX	355	1e-41	88
5904	10118	701119423H1	SOYMON037	g296203	BLASTN	575	1e-39	67
5905	10118	700872879H1	SOYMON018	g296204	BLASTX	312	1e-35	82
5906	10118	700973420H1	SOYMON005	g296204	BLASTX	260	1e-31	66
5907	12859	700562950H1	SOYMON002	g296203	BLASTN	685	1e-48	74
5908	12859	700971319H1	SOYMON005	g296204	BLASTX	273	1e-38	76
5909	17267	700555074H1	SOYMON001	g1353352	BLASTX	378	1e-45	79
5910	17267	700555060H1	SOYMON001	g1353352	BLASTX	378	1e-45	79
5911	17267	700743751H1	SOYMON012	g1353352	BLASTX	133	1e-11	61
5912	19812	700896952H1	SOYMON027	g296203	BLASTN	468	1e-30	67
5913	19812	700659743H1	SOYMON004	g296203	BLASTN	451	1e-27	67
5914	31650	700874484H1	SOYMON018	g1353352	BLASTX	118	1e-9	59
5915	5883	701001504H1	SOYMON018	g296203	BLASTN	714	1e-50	73
5916	5883	700969537H1	SOYMON005	g296203	BLASTN	598	1e-41	70
5917	5883	700672092H1	SOYMON006	g296203	BLASTN	601	1e-41	72
5918	5883	700961520H1	SOYMON022	g296203	BLASTN	584	1e-39	72
5919	5883	701141195H1	SOYMON038	g296204	BLASTX	153	1e-14	75
5920	6292	700559647H1	SOYMON001	g1353352	BLASTX	292	1e-33	51
5921	6292	700556715H1	SOYMON001	g1353352	BLASTX	292	1e-33	53
5922	6292	701001051H1	SOYMON018	g1353352	BLASTX	293	1e-33	58
5923	6292	700682468H2	SOYMON008	g1353352	BLASTX	261	1e-29	51
5924	6292	700973534H1	SOYMON005	g1353352	BLASTX	263	1e-29	54
5925	6292	700874672H1	SOYMON018	g1353352	BLASTX	150	1e-28	55
5926	6292	700893193H1	SOYMON024	g296204	BLASTX	256	1e-28	58
5927	6292	700681610H1	SOYMON008	g296204	BLASTX	259	1e-28	58
5928	6292	701002246H1	SOYMON018	g296204	BLASTX	159	1e-27	56
5929	6292	700956467H1	SOYMON022	g1353352	BLASTX	238	1e-27	58
5930	6292	700888645H1	SOYMON024	g296204	BLASTX	196	1e-20	60
5931	6292	701002201H1	SOYMON018	g296204	BLASTX	156	1e-16	57
5932	6292	700680675H1	SOYMON008	g469148	BLASTX	119	1e-9	63
5933	6292	701050803H1	SOYMON032	g296204	BLASTX	120	1e-9	58
5934	6594	700684722H1	SOYMON008	g1353352	BLASTX	157	1e-22	69
5935	6594	700872191H1	SOYMON018	g1353352	BLASTX	129	1e-16	61
5936	698	700738627H1	SOYMON012	g1353352	BLASTX	333	1e-39	73

5937	698	700681703H1	SOYMON008	g1353352	BLASTX	319	1e-37	76
5938	698	700961778H1	SOYMON022	g1353352	BLASTX	316	1e-36	79
5939	698	700666316H1	SOYMON005	g1353352	BLASTX	298	1e-34	77
5940	698	700685706H1	SOYMON008	g1353352	BLASTX	293	1e-33	72
5941	698	700739093H1	SOYMON012	g1353352	BLASTX	172	1e-29	73
5942	698	700666387H1	SOYMON005	g1353352	BLASTX	267	1e-29	76
5943	698	700993520H1	SOYMON011	g1353352	BLASTX	255	1e-28	63
5944	698	700896371H1	SOYMON027	g1353352	BLASTX	255	1e-28	80
5945	698	700997253H1	SOYMON018	g1353352	BLASTX	260	1e-28	65
5946	698	700995571H1	SOYMON011	g1353352	BLASTX	260	1e-28	63
5947	698	700648011H1	SOYMON003	g1353352	BLASTX	239	1e-25	66
5948	698	700850732H1	SOYMON023	g1353352	BLASTX	204	1e-21	78
5949	698	700557773H1	SOYMON001	g1353352	BLASTX	208	1e-21	81
5950	698	700874138H1	SOYMON018	g1353352	BLASTX	208	1e-21	81
5951	698	700559725H1	SOYMON001	g1353352	BLASTX	201	1e-20	82
5952	698	701105639H1	SOYMON036	g1353352	BLASTX	202	1e-20	80
5953	698	700994494H1	SOYMON011	g1353352	BLASTX	186	1e-18	83
5954	698	700738237H1	SOYMON012	g1353352	BLASTX	186	1e-18	78
5955	698	700555071H1	SOYMON001	g1353352	BLASTX	186	1e-18	83
5956	698	700786177H2	SOYMON011	g1353352	BLASTX	171	1e-17	54
5957	698	700554414H1	SOYMON001	g1353352	BLASTX	176	1e-17	84
5958	698	700741128H1	SOYMON012	g1353352	BLASTX	176	1e-17	82
5959	698	700965158H1	SOYMON022	g1353352	BLASTX	176	1e-17	82
5960	698	700685250H1	SOYMON008	g1353352	BLASTX	179	1e-17	80
5961	698	700991457H1	SOYMON011	g1353352	BLASTX	180	1e-17	82
5962	698	700684192H1	SOYMON008	g1353352	BLASTX	180	1e-17	82
5963	698	700871122H1	SOYMON018	g1353352	BLASTX	180	1e-17	82
5964	698	700997304H1	SOYMON018	g1353352	BLASTX	182	1e-17	70
5965	698	700685731H1	SOYMON008	g1353352	BLASTX	172	1e-16	82
5966	698	700685724H1	SOYMON008	g1353352	BLASTX	172	1e-16	82
5967	698	700739069H1	SOYMON012	g1353352	BLASTX	161	1e-15	83
5968	698	700741337H1	SOYMON012	g1353352	BLASTX	164	1e-15	81
5969	698	700683155H1	SOYMON008	g1353352	BLASTX	164	1e-15	81
5970	698	700994202H1	SOYMON011	g1353352	BLASTX	165	1e-15	73
5971	698	700555575H1	SOYMON001	g1353352	BLASTX	166	1e-15	79
5972	698	701000739H1	SOYMON018	g1353352	BLASTX	167	1e-15	63
5973	698	700740011H1	SOYMON012	g1353352	BLASTX	153	1e-14	83
5974	698	700994043H1	SOYMON011	g1353352	BLASTX	157	1e-14	81
5975	698	700555709H1	SOYMON001	g1353352	BLASTX	87	1e-12	76
5976	698	701107588H1	SOYMON036	g1353352	BLASTX	114	1e-12	68
5977	698	700871057H1	SOYMON018	g1353352	BLASTX	139	1e-12	77
5978	698	700744973H1	SOYMON013	g1353352	BLASTX	141	1e-12	79
5979	698	700741744H1	SOYMON012	g1353352	BLASTX	141	1e-12	79
5980	698	700792044H1	SOYMON011	g1353352	BLASTX	142	1e-12	63
5981	698	700993716H1	SOYMON011	g1353352	BLASTX	83	1e-11	83
5982	698	700684326H1	SOYMON008	g1353352	BLASTX	137	1e-11	81
5983	698	700989256H1	SOYMON011	g1353352	BLASTX	124	1e-10	77
5984	698	700791590H1	SOYMON011	g1353352	BLASTX	130	1e-10	78
5985	698	700872519H1	SOYMON018	g1353352	BLASTX	78	1e-9	78
5986	698	700645949H1	SOYMON011	g1353352	BLASTX	106	1e-9	63
5987	698	700996252H1	SOYMON018	g1353352	BLASTX	125	1e-9	77
5988	698	700876656H1	SOYMON018	g1353352	BLASTX	74	1e-8	79
5989	698	700874318H1	SOYMON018	g1353352	BLASTX	113	1e-8	73
5990	698	700737927H1	SOYMON012	g1353352	BLASTX	114	1e-8	73

5991	9687	700740448H1	SOYMON012	g1353352	BLASTX	262	1e-29	57
5992	9687	700954623H1	SOYMON022	g1353352	BLASTX	265	1e-29	56
5993	9687	701142577H1	SOYMON038	g1353352	BLASTX	247	1e-27	56
5994	9687	701000510H1	SOYMON018	g1353352	BLASTX	235	1e-25	65
5995	9687	700874683H1	SOYMON018	g1353352	BLASTX	212	1e-22	58
5996	9687	700874576H1	SOYMON018	g1353352	BLASTX	117	1e-17	54
5997	9687	700999910H1	SOYMON018	g1353352	BLASTX	163	1e-15	54
5998	9687	701001711H1	SOYMON018	g1353352	BLASTX	116	1e-8	64
5999	10017	LIB3030-005-Q1-B1-F1	LIB3030	g296204	BLASTX	159	1e-38	72
6000	10017	LIB3051-078-Q1-K1-B5	LIB3051	g296204	BLASTX	207	1e-37	61
6001	10017	LIB3051-006-Q1-K1-D5	LIB3051	g296203	BLASTN	543	1e-34	68
6002	10017	LIB3051-006-Q1-E1-D5	LIB3051	g469147	BLASTN	306	1e-14	69
6003	10017	LIB3051-113-Q1-K1-B4	LIB3051	g469147	BLASTN	301	1e-13	63
6004	698	LIB3028-005-Q1-B1-A11	LIB3028	g1353352	BLASTX	110	1e-34	69

#### MAIZE NADP-DEPENDENT MALIC ENZYME

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6005	-700041501	700041501H1	SATMON004	g168527	BLASTN	529	1e-35	93
6006	-700051224	700051224H1	SATMON003	g20468	BLASTN	514	1e-32	81
6007	-700073375	700073375H1	SATMON007	g168527	BLASTN	584	1e-58	77
6008	-700101813	700101813H1	SATMON009	g168527	BLASTN	920	1e-88	100
6009	-700104958	700104958H1	SATMON010	g168527	BLASTN	363	1e-19	92
6010	-700219021	700219021H1	SATMON011	g1785859	BLASTN	467	1e-28	80
6011	-700346164	700346164H1	SATMON021	g510876	BLASTX	102	1e-18	78
6012	-700453338	700453338H1	SATMON028	g20468	BLASTN	716	1e-50	79
6013	-700460886	700460886H1	SATMON031	g168527	BLASTN	191	1e-14	92
6014	-700573176	700573176H1	SATMON030	g168527	BLASTN	277	1e-25	80
6015	-701182650	701182650H1	SATMONN06	g169326	BLASTN	572	1e-51	79
6016	10304	700349609H1	SATMON023	g20468	BLASTN	939	1e-69	81
6017	10304	700050528H1	SATMON003	g20468	BLASTN	945	1e-69	80
6018	10304	700242979H1	SATMON010	g20468	BLASTN	926	1e-68	82
6019	10304	700577075H1	SATMON031	g20468	BLASTN	919	1e-67	81
6020	10304	700381724H1	SATMON023	g20468	BLASTN	507	1e-59	76
6021	18769	700050667H1	SATMON003	g20468	BLASTN	452	1e-29	76
6022	18769	700076676H1	SATMON007	g20469	BLASTX	181	1e-18	77
6023	18769	700155440H1	SATMON007	g20469	BLASTX	140	1e-12	73
6024	2190	700071978H1	SATMON007	g425803	BLASTN	1045	1e-80	83
6025	2190	700202802H1	SATMON003	g425803	BLASTN	440	1e-79	81
6026	2190	700104846H1	SATMON010	g425803	BLASTN	537	1e-73	83
6027	2190	700444338H1	SATMON027	g425803	BLASTN	677	1e-65	84
6028	2190	700457069H1	SATMON029	g425803	BLASTN	428	1e-56	81
6029	2190	700457021H1	SATMON029	g425803	BLASTN	753	1e-56	83
6030	2190	701181152H1	SATMONN06	g1785859	BLASTN	577	1e-54	78
6031	2190	700445983H1	SATMON027	g1785859	BLASTN	607	1e-52	74
6032	2190	700142607H2	SATMON013	g1785859	BLASTN	684	1e-48	78
6033	412	700097657H1	SATMON009	g168527	BLASTN	1648	1e-128	99
6034	412	700098574H1	SATMON009	g168527	BLASTN	1605	1e-124	99

6035	412	700099850H1	SATMON009	g168527	BLASTN	1537	1e-119	97
6036	412	700097455H1	SATMON009	g168527	BLASTN	1527	1e-118	99
6037	412	700097222H1	SATMON009	g168527	BLASTN	1530	1e-118	98
6038	412	700097391H1	SATMON009	g168527	BLASTN	1520	1e-117	98
6039	412	700097849H1	SATMON009	g168527	BLASTN	1504	1e-116	99
6040	412	700101666H1	SATMON009	g168527	BLASTN	1495	1e-115	100
6041	412	700099890H1	SATMON009	g168527	BLASTN	1468	1e-113	98
6042	412	700097237H1	SATMON009	g168527	BLASTN	1313	1e-112	98
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6048	412	700044315H1	SATMON004	g168527	BLASTN	1390	1e-106	100
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6050	412	700434125H1	SATMONN01	g168527	BLASTN	1374	1e-105	97
6051	412	700041705H1	SATMON004	g168527	BLASTN	1311	1e-104	99
6052	412	700104088H1	SATMON010	g168527	BLASTN	1361	1e-104	92
6053	412	700614919H1	SATMON033	g168527	BLASTN	1103	1e-103	86
6054	412	700613108H1	SATMON033	g168527	BLASTN	1345	1e-103	89
6055	412	700042025H1	SATMON004	g168527	BLASTN	1352	1e-103	99
6056	412	700467944H1	SATMON025	g168527	BLASTN	1353	1e-103	95
6057	412	700617354H1	SATMON033	g168527	BLASTN	1354	1e-103	89
6058	412	700095156H1	SATMON008	g168527	BLASTN	1354	1e-103	92
6059	412	700448457H1	SATMON027	g168527	BLASTN	722	1e-102	93
6060	412	700581224H1	SATMON031	g168527	BLASTN	872	1e-101	98
6061	412	700426724H1	SATMONN01	g168527	BLASTN	1322	1e-101	98
6062	412	700105096H1	SATMON010	g168527	BLASTN	707	1e-100	93
6063	412	700045272H1	SATMON004	g168527	BLASTN	1311	1e-100	99
6064	412	700577375H1	SATMON031	g168527	BLASTN	1300	1e-99	100
6065	412	700044113H1	SATMON004	g168527	BLASTN	1300	1e-99	100
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6067	412	700582457H1	SATMON031	g168527	BLASTN	1305	1e-99	98
6068	412	700580693H1	SATMON031	g168527	BLASTN	975	1e-98	97
6069	412	700577922H1	SATMON031	g168527	BLASTN	1111	1e-98	95
6070	412	700043222H1	SATMON004	g168527	BLASTN	1289	1e-98	99
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6089	412	700479665H1	SATMON034	g168527	BLASTN	1199	1e-91	93
6090	412	700242318H1	SATMON010	g168527	BLASTN	1200	1e-91	96
6091	412	700262339H1	SATMON017	g168527	BLASTN	924	1e-90	91
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6093	412	700580501H1	SATMON031	g168527	BLASTN	674	1e-89	91
6094	412	700430624H1	SATMONN01	g168527	BLASTN	839	1e-89	96
6095	412	700798989H1	SATMON036	g168527	BLASTN	1176	1e-89	90
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6097	412	700572903H1	SATMON030	g168527	BLASTN	771	1e-88	89
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6103	412	700612607H1	SATMON033	g168527	BLASTN	634	1e-86	91
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6107	412	700106553H1	SATMON010	g168527	BLASTN	888	1e-83	87
6108	412	700101622H1	SATMON009	g168527	BLASTN	1105	1e-83	100
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6110	412	701183573H1	SATMONN06	g168527	BLASTN	1098	1e-82	89
6111	412	700355825H1	SATMON024	g168527	BLASTN	1102	1e-82	88
6112	412	700171967H1	SATMON013	g168527	BLASTN	1085	1e-81	92
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6114	412	701160628H1	SATMONN04	g168527	BLASTN	624	1e-79	89
6115	412	700020733H1	SATMON001	g168527	BLASTN	1048	1e-78	92
6116	412	700575032H1	SATMON030	g168527	BLASTN	493	1e-77	91
6117	412	700241204H1	SATMON010	g168527	BLASTN	812	1e-77	88
6118	412	700447091H1	SATMON027	g168527	BLASTN	991	1e-77	91
6119	412	700469827H1	SATMON025	g168527	BLASTN	643	1e-76	87
6120	412	700043868H1	SATMON004	g168527	BLASTN	1020	1e-76	100
6121	412	700167416H1	SATMON013	g168527	BLASTN	1021	1e-76	92
6122	412	700166313H1	SATMON013	g168527	BLASTN	1010	1e-75	93
6123	412	700477627H1	SATMON025	g168527	BLASTN	1010	1e-75	88
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6125	412	700027363H1	SATMON003	g168527	BLASTN	402	1e-73	92
6126	412	700569811H1	SATMON030	g168527	BLASTN	593	1e-71	89
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6129	412	700171193H1	SATMON013	g168527	BLASTN	935	1e-69	89
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6133	412	700154717H1	SATMON007	g168527	BLASTN	893	1e-65	90
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6141	412	700613195H1	SATMON033	g168527	BLASTN	633	1e-53	83
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6143	412	700439831H1	SATMON026	g168527	BLASTN	498	1e-50	95
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6145	412	700224833H1	SATMON011	g168527	BLASTN	636	1e-44	89
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6147	412	700577851H1	SATMON031	g168527	BLASTN	637	1e-44	95
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6150	412	700614366H1	SATMON033	g415314	BLASTN	644	1e-44	88
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6154	412	700098372H1	SATMON009	g168527	BLASTN	596	1e-40	99
6155	412	700432379H1	SATMONN01	g168527	BLASTN	341	1e-39	94
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6157	412	700090392H1	SATMON011	g168527	BLASTN	532	1e-35	90
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6159	412	700042404H1	SATMON004	g168527	BLASTN	525	1e-34	100
6160	412	700465190H1	SATMON025	g168527	BLASTN	509	1e-33	87
6161	412	700260024H1	SATMON017	g168527	BLASTN	210	1e-32	94
6162	412	700579166H1	SATMON031	g168527	BLASTN	413	1e-32	96
6163	412	700049441H1	SATMON003	g168527	BLASTN	303	1e-31	90
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6165	412	700259602H1	SATMON017	g168527	BLASTN	297	1e-26	89
6166	412	700467465H1	SATMON025	g168527	BLASTN	420	1e-26	96
6167	412	700215437H1	SATMON016	g168527	BLASTN	306	1e-20	86
6168	412	700265281H1	SATMON017	g168527	BLASTN	359	1e-19	89
6169	6503	700083127H1	SATMON011	g168528	BLASTX	124	1e-10	92
6170	9238	700336628H1	SATMON019	g168527	BLASTN	435	1e-34	74
6171	9238	700017544H1	SATMON001	g168527	BLASTN	513	1e-33	74
6172	-L1485987	LIB148-042-Q1-E1-D11	LIB148	g415314	BLASTN	566	1e-38	76
6173	-L30602419	LIB3060-012-Q1-K1-E8	LIB3060	g168527	BLASTN	723	1e-51	96
6174	-L30611342	LIB3061-002-Q1-K1-H10	LIB3061	g168527	BLASTN	633	1e-43	77
6175	-L30662912	LIB3066-008-Q1-K1-A2	LIB3066	g2911148	BLASTX	147	1e-29	84
6176	-L30664918	LIB3066-021-Q1-K1-B5	LIB3066	g168527	BLASTN	838	1e-60	71
6177	-L30672727	LIB3067-039-Q1-K1-C10	LIB3067	g168527	BLASTN	401	1e-42	82
6178	-L30782241	LIB3078-007-Q1-K1-A1	LIB3078	g168527	BLASTN	393	1e-36	79
6179	-L30783451	LIB3078-050-Q1-K1-G11	LIB3078	g168527	BLASTN	199	1e-9	83
6180	-L30784158	LIB3078-035-Q1-K1-H5	LIB3078	g168527	BLASTN	201	1e-14	91
6181	30424	LIB3060-024-Q1-K1-D9	LIB3060	g415314	BLASTN	1355	1e-104	79
6182	412	LIB3078-022-Q1-K1-D10	LIB3078	g168527	BLASTN	2209	1e-175	95
6183	412	LIB3060-021-Q1-K1-G10	LIB3060	g168527	BLASTN	2203	1e-174	99
6184	412	LIB189-006-	LIB189	g168527	BLASTN	2121	1e-167	99

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6185	412	LIB189-010-Q1-E1-C4	LIB189	g168527	BLASTN	1749	1e-164	98
6186	412	LIB189-029-Q1-E1-A5	LIB189	g168527	BLASTN	2067	1e-163	98
6187	412	LIB36-021-Q1-E1-D12	LIB36	g168527	BLASTN	2011	1e-158	97
6188	412	LIB36-003-Q1-E1-B4	LIB36	g168527	BLASTN	1988	1e-156	95
6189	412	LIB36-017-Q1-E1-D7	LIB36	g168527	BLASTN	1503	1e-155	98
6190	412	LIB189-018-Q1-E1-D11	LIB189	g168527	BLASTN	1977	1e-155	97
6191	412	LIB189-014-Q1-E1-D11	LIB189	g168527	BLASTN	1941	1e-152	97
6192	412	LIB3078-049-Q1-K1-G10	LIB3078	g168527	BLASTN	1810	1e-151	94
6193	412	LIB3078-012-Q1-K1-E8	LIB3078	g168527	BLASTN	1874	1e-151	93
6194	412	LIB36-018-Q1-E1-B9	LIB36	g168527	BLASTN	1466	1e-150	97
6195	412	LIB36-012-Q1-E1-H9	LIB36	g168527	BLASTN	1901	1e-149	98
6196	412	LIB189-027-Q1-E1-C5	LIB189	g168527	BLASTN	1903	1e-149	95
6197	412	LIB84-005-Q1-E1-A11	LIB84	g168527	BLASTN	1889	1e-148	96
6198	412	LIB189-018-Q1-E1-G7	LIB189	g168527	BLASTN	1814	1e-144	97
6199	412	LIB3079-004-Q1-K1-A10	LIB3079	g168527	BLASTN	1724	1e-140	91
6200	412	LIB189-028-Q1-E1-F11	LIB189	g168527	BLASTN	1740	1e-140	99
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6202	412	LIB3060-002-Q1-K2-A8	LIB3060	g168527	BLASTN	1779	1e-139	95
6203	412	LIB3067-049-Q1-K1-F5	LIB3067	g168527	BLASTN	1098	1e-137	88
6204	412	LIB3062-026-Q1-K1-C8	LIB3062	g168527	BLASTN	1428	1e-135	89
6205	412	LIB3059-011-Q1-K1-C4	LIB3059	g168527	BLASTN	1651	1e-128	87
6206	412	LIB3061-002-Q1-K2-H10	LIB3061	g168527	BLASTN	1618	1e-125	89
6207	412	LIB3060-008-Q1-K1-H3	LIB3060	g168527	BLASTN	990	1e-122	97
6208	412	LIB3060-020-Q1-K1-E10	LIB3060	g168527	BLASTN	1322	1e-121	89
6209	412	LIB189-032-Q1-E1-E7	LIB189	g168527	BLASTN	680	1e-120	94
6210	412	LIB36-019-Q1-E1-F11	LIB36	g168527	BLASTN	1197	1e-115	97
6211	412	LIB3062-038-	LIB3062	g168527	BLASTN	1498	1e-115	91

6212	412	Q1-K1-D1 LIB189-029-	LIB189	g168527	BLASTN	1175	1e-113	95
6213	412	Q1-E1-A4 LIB36-022-	LIB36	g168527	BLASTN	1393	1e-107	98
6214	412	Q1-E1-F12 LIB3079-001-	LIB3079	g168527	BLASTN	1243	1e-103	82
6215	412	Q1-K1-H3 LIB189-014-	LIB189	g168527	BLASTN	855	1e-99	91
6216	412	Q1-E1-D12 LIB189-026-	LIB189	g168527	BLASTN	1167	1e-93	94
6217	412	Q1-E1-C1 LIB3079-001-	LIB3079	g168527	BLASTN	480	1e-78	84
6218	412	Q1-K1-H5 LIB36-008-	LIB36	g168527	BLASTN	576	1e-75	97
6219	412	Q1-E1-C5 LIB83-015-	LIB83	g168527	BLASTN	446	1e-59	92
6220	412	Q1-E1-G7 LIB3062-024-	LIB3062	g168527	BLASTN	455	1e-53	77
6221	412	Q1-K1-D2 LIB3062-026-	LIB3062	g168527	BLASTN	561	1e-50	78
6222	412	Q1-K1-C4 LIB83-013-	LIB83	g168527	BLASTN	637	1e-44	95
6223	412	Q1-E1-E12 LIB83-002-	LIB83	g168527	BLASTN	564	1e-43	97
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# SOYBEAN NADP-DEPENDENT MALIC ENZYME

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6224	-700698057	700698057H1	SOYMON015	g168527	BLASTN	513	1e-67	90
6225	-700744209	700744209H1	SOYMON013	g1679885	BLASTX	138	1e-12	69
6226	-700979875	700979875H2	SOYMON009	g20468	BLASTN	236	1e-8	82
6227	-701013601	701013601H1	SOYMON019	g20469	BLASTX	184	1e-18	60
6228	-701054477	701054477H1	SOYMON032	g169326	BLASTN	1122	1e-84	94
6229	-701206630	701206630H1	SOYMON035	g1679885	BLASTX	142	1e-14	85
6230	11537	700653458H1	SOYMON003	g20468	BLASTN	1173	1e-88	83
6231	11537	700650905H1	SOYMON003	g20468	BLASTN	886	1e-74	83
6232	11537	701141562H1	SOYMON038	g20468	BLASTN	532	1e-52	78
6233	11537	701144577H1	SOYMON031	g20468	BLASTN	624	1e-50	81
6234	11537	700748911H1	SOYMON013	g18460	BLASTX	91	1e-14	100
6235	11795	700667578H1	SOYMON006	g169326	BLASTN	1118	1e-84	95
6236	11795	701056334H1	SOYMON032	g169326	BLASTN	658	1e-82	94
6237	11795	700742616H1	SOYMON012	g169326	BLASTN	848	1e-61	95
6238	12499	701051365H1	SOYMON032	g169326	BLASTN	1237	1e-94	92
6239	12499	701102792H1	SOYMON028	g169326	BLASTN	1169	1e-88	92
6240	12499	701098731H2	SOYMON028	g169326	BLASTN	1031	1e-82	91
6241	15256	700744584H1	SOYMON013	g20469	BLASTX	96	1e-9	85
6242	1729	701000647H1	SOYMON018	g20468	BLASTN	766	1e-61	81
6243	1729	700738988H1	SOYMON012	g2150026	BLASTN	745	1e-53	85
6244	1729	700956234H1	SOYMON022	g20468	BLASTN	740	1e-52	74
6245	1729	700888666H1	SOYMON024	g2150026	BLASTN	626	1e-43	83
6246	1729	700752533H1	SOYMON014	g2150026	BLASTN	431	1e-34	80
6247	1729	700685485H1	SOYMON008	g459441	BLASTX	163	1e-15	82
6248	1729	700998862H1	SOYMON018	g20469	BLASTX	147	1e-14	73

6249	1729	700729313H1	SOYMON009	g2150029	BLASTX	85	1e-10	75
6250	17352	700846094H1	SOYMON021	g20468	BLASTN	700	1e-49	76
6251	17352	701062346H1	SOYMON033	g20468	BLASTN	658	1e-45	86
6252	17352	700866471H1	SOYMON016	g169326	BLASTN	511	1e-39	84
6253	21165	701129419H1	SOYMON037	g169326	BLASTN	1098	1e-85	92
6254	21165	701099310H1	SOYMON028	g169326	BLASTN	534	1e-54	87
6255	21165	701103522H1	SOYMON028	g169326	BLASTN	764	1e-54	92
6256	21165	701050730H1	SOYMON032	g169326	BLASTN	460	1e-43	88
6257	21165	701045037H1	SOYMON032	g169326	BLASTN	536	1e-43	89
6258	21165	701050806H1	SOYMON032	g169326	BLASTN	515	1e-41	89
6259	21165	700749793H1	SOYMON013	g169326	BLASTN	258	1e-40	86
6260	23648	701045082H1	SOYMON032	g169326	BLASTN	825	1e-80	94
6261	23648	701118383H1	SOYMON037	g169326	BLASTN	475	1e-30	88
6262	24404	700737869H1	SOYMON012	g169326	BLASTN	460	1e-44	86
6263	3053	701212666H1	SOYMON035	g20468	BLASTN	868	1e-63	84
6264	3053	701212028H1	SOYMON035	g20468	BLASTN	631	1e-61	80
6265	3053	700977561H1	SOYMON009	g20468	BLASTN	841	1e-61	79
6266	3053	700905407H1	SOYMON022	g20468	BLASTN	843	1e-61	84
6267	3053	700792066H1	SOYMON011	g20468	BLASTN	776	1e-55	79
6268	3053	701128564H1	SOYMON037	g20468	BLASTN	708	1e-50	78
6269	3053	700946436H1	SOYMON024	g20468	BLASTN	683	1e-48	75
6270	3053	701137311H1	SOYMON038	g20468	BLASTN	379	1e-39	80
6271	3053	700977732H1	SOYMON009	g20468	BLASTN	279	1e-37	77
6272	32402	700843745H1	SOYMON021	g2150027	BLASTX	164	1e-15	88
6273	7467	700998015H1	SOYMON018	g2150026	BLASTN	600	1e-46	73
6274	7467	701051278H1	SOYMON032	g2150026	BLASTN	594	1e-40	79
6275	7467	700742622H1	SOYMON012	g2150026	BLASTN	582	1e-39	79
6276	7467	700672459H1	SOYMON006	g2911148	BLASTX	201	1e-20	90
6277	7467	700668110H1	SOYMON006	g2911148	BLASTX	201	1e-20	90
6278	7467	701067027H1	SOYMON034	g169326	BLASTN	356	1e-20	78
6279	7467	700740551H1	SOYMON012	g2150027	BLASTX	138	1e-11	60
6280	7507	700725450H1	SOYMON009	g20468	BLASTN	888	1e-65	81
6281	7507	700863501H1	SOYMON027	g20468	BLASTN	873	1e-63	79
6282	7507	700961324H1	SOYMON022	g20468	BLASTN	748	1e-53	77
6283	7507	700648881H1	SOYMON003	g20468	BLASTN	443	1e-46	76
6284	7507	700727322H1	SOYMON009	g2150027	BLASTX	196	1e-19	90
6285	32402	LIB3055-009-Q1-N1-E5	LIB3055	g2150028	BLASTN	458	1e-27	80
6286	7467	LIB3051-044-Q1-K1-A10	LIB3051	g169326	BLASTN	633	1e-42	76
6287	7507	LIB3050-004-Q1-E1-B1	LIB3050	g20468	BLASTN	635	1e-42	80

#### MAIZE NAD-DEPENDENT MALIC ENZYME

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6022	18769	700076676H1	SATMON007	g20469	BLASTX	181	1e-18	77
6023	18769	700155440H1	SATMON007	g20469	BLASTX	140	1e-12	73
6288	-701172938	701172938H2	SATMONN05	g438131	BLASTX	95	1e-18	77
6289	18115	700217870H1	SATMON016	g438131	BLASTX	157	1e-14	84
6290	-700455719	700455719H1	SATMON029	g1129068	BLASTX	137	1e-14	72

# SOYBEAN NAD-DEPENDENT MALIC ENZYME

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6291	-700565009	700565009H1	SOYMON002	g438131	BLASTX	126	1e-10	73
6292	-701041607	701041607H1	SOYMON029	g437104	BLASTX	124	1e-21	76
6293	-GM32323	LIB3051-012-Q1-E1-H7	LIB3051	g438131	BLASTX	152	1e-31	89

# MAIZE PEP CARBOXYKINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6294	-700442004	700442004H1	SATMON026	g607751	BLASTN	348	1e-21	71
6295	-700579766	700579766H1	SATMON031	g607751	BLASTN	223	1e-16	79
6296	-700619673	700619673H1	SATMON034	g607751	BLASTN	281	1e-15	87
6297	15221	700620909H1	SATMON034	g607751	BLASTN	657	1e-66	88
6298	15221	700620957H1	SATMON034	g607751	BLASTN	657	1e-51	88
6299	1650	700098127H1	SATMON009	g607751	BLASTN	1241	1e-100	91
6300	1650	700243074H1	SATMON010	g607751	BLASTN	1190	1e-90	92
6301	1650	700098909H1	SATMON009	g607751	BLASTN	662	1e-89	89
6302	1650	700578805H1	SATMON031	g607751	BLASTN	783	1e-84	92
6303	1650	700577590H1	SATMON031	g607751	BLASTN	1116	1e-84	91
6304	1650	700576768H1	SATMON031	g607751	BLASTN	885	1e-83	93
6305	1650	700025522H1	SATMON004	g607751	BLASTN	1097	1e-82	93
6306	1650	700197175H1	SATMON014	g607751	BLASTN	1067	1e-80	93
6307	1650	700432603H1	SATMONN01	g607751	BLASTN	659	1e-76	92
6308	1650	700193379H1	SATMON014	g607751	BLASTN	976	1e-72	91
6309	1650	700196761H1	SATMON014	g607751	BLASTN	718	1e-50	92
6310	1650	700441535H1	SATMON026	g607751	BLASTN	391	1e-36	84
6311	1650	700158221H1	SATMON012	g607751	BLASTN	307	1e-28	92
6312	20890	700101572H1	SATMON009	g607751	BLASTN	1300	1e-99	90
6313	20890	700099023H1	SATMON009	g607751	BLASTN	1139	1e-86	89
6314	20890	700577054H1	SATMON031	g607751	BLASTN	587	1e-79	90
6315	20890	700458441H1	SATMON029	g607751	BLASTN	1025	1e-76	85
6316	22085	700101950H1	SATMON009	g607751	BLASTN	273	1e-19	85
6317	22085	700101726H1	SATMON009	g607751	BLASTN	282	1e-12	92
6318	22085	700045944H1	SATMON004	g607751	BLASTN	268	1e-11	91
6319	22085	700099310H1	SATMON009	g607751	BLASTN	269	1e-11	89
6320	22085	700097484H1	SATMON009	g607751	BLASTN	245	1e-9	88
6321	22085	700101996H1	SATMON009	g607751	BLASTN	245	1e-9	85
6322	28836	700168982H1	SATMON013	g607751	BLASTN	195	1e-9	78
6323	3602	700098761H1	SATMON009	g607751	BLASTN	688	1e-94	87
6324	3602	700240336H1	SATMON010	g607751	BLASTN	1023	1e-76	89
6325	3602	701158475H1	SATMONN04	g607751	BLASTN	907	1e-66	86
6326	8009	700028978H1	SATMON003	g607751	BLASTN	681	1e-83	89
6327	8009	700440427H1	SATMON026	g607751	BLASTN	726	1e-72	89
6328	8009	700440419H1	SATMON026	g607751	BLASTN	715	1e-67	87
6329	8009	700578684H1	SATMON031	g607751	BLASTN	720	1e-66	84
6330	-L1433016	LIB143-017-Q1-E1-G12	LIB143	g607751	BLASTN	344	1e-17	77
6331	-L1892500	LIB189-018-Q1-E1-A7	LIB189	g607751	BLASTN	483	1e-29	77
6332	-L30604864	LIB3060-022-Q1-K1-A10	LIB3060	g607751	BLASTN	266	1e-11	89
6333	1650	LIB3069-045-Q1-K1-A5	LIB3069	g607751	BLASTN	1868	1e-146	91

6334	1650	LIB189-002-Q1-E1-F5	LIB189	g607751	BLASTN	1532	1e-118	92
6335	1650	LIB84-013-Q1-E1-D8	LIB84	g607751	BLASTN	1316	1e-100	88
6336	1650	LIB143-049-Q1-E1-D10	LIB143	g607751	BLASTN	1233	1e-93	91
6337	20890	10-LIB189-016-Q1-E1-C9	LIB189	g607751	BLASTN	1467	1e-113	86
6338	22085	LIB3060-018-Q1-K1-C8	LIB3060	g607751	BLASTN	288	1e-41	73
6339	22085	LIB3060-028-Q1-K1-F4	LIB3060	g567102	BLASTX	132	1e-38	66
6340	22085	LIB143-052-Q1-E1-B12	LIB143	g607751	BLASTN	288	1e-32	84
6341	22085	LIB3060-025-Q1-K1-F9	LIB3060	g607751	BLASTN	280	1e-28	85
6342	22085	LIB3060-005-Q1-K1-G11	LIB3060	g607751	BLASTN	280	1e-27	84
6343	22085	LIB3060-045-Q1-K1-A8	LIB3060	g607751	BLASTN	280	1e-22	79
6344	22085	LIB3060-036-Q1-K1-G2	LIB3060	g607751	BLASTN	280	1e-17	85
6345	22085	LIB3060-045-Q1-K1-E8	LIB3060	g607751	BLASTN	280	1e-17	88
6346	22085	LIB3060-001-Q1-K2-G11	LIB3060	g607751	BLASTN	280	1e-12	90
6347	22085	LIB3060-007-Q1-K1-A4	LIB3060	g607751	BLASTN	280	1e-12	92
6348	22085	LIB3060-007-Q1-K1-D2	LIB3060	g607751	BLASTN	273	1e-11	91
6349	22085	LIB189-007-Q1-E1-H6	LIB189	g607751	BLASTN	259	1e-10	88
6350	28836	LIB143-067-Q1-E1-E12	LIB143	g607751	BLASTN	281	1e-12	91
6351	3602	LIB3060-024-Q1-K1-F3	LIB3060	g607751	BLASTN	1188	1e-112	81
6352	8009	LIB189-023-Q1-E1-H8	LIB189	g607751	BLASTN	758	1e-110	85
6353	8009	LIB3060-013-Q1-K1-F1	LIB3060	g607751	BLASTN	1184	1e-99	87

# SOYBEAN PEP CARBOXYKINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6354	-700654736	700654736H1	SOYMON004	g567102	BLASTX	204	1e-21	86
6355	-700848574	700848574H1	SOYMON021	g567101	BLASTN	741	1e-52	80
6356	-700866163	700866163H1	SOYMON016	g567102	BLASTX	60	1e-10	71
6357	-700868677	700868677H1	SOYMON016	g914915	BLASTX	163	1e-15	65
6358	-700943040	700943040H1	SOYMON024	g567101	BLASTN	405	1e-23	82
6359	-700972225	700972225H1	SOYMON005	g567101	BLASTN	588	1e-47	82
6360	-700996224	700996224H1	SOYMON018	g567101	BLASTN	563	1e-38	83
6361	-701045039	701045039H1	SOYMON032	g914914	BLASTN	581	1e-54	82
6362	12737	700605402H2	SOYMON004	g567101	BLASTN	809	1e-58	76
6363	12737	700888213H1	SOYMON024	g607751	BLASTN	361	1e-19	75

6364	13320	701040204H1	SOYMON029	g914914	BLASTN	1002	1e-74	81
6365	13320	701042078H1	SOYMON029	g914914	BLASTN	865	1e-63	81
6366	13320	700849715H1	SOYMON021	g914914	BLASTN	745	1e-53	83
6367	17750	700959272H1	SOYMON022	g567102	BLASTX	154	1e-13	53
6368	17750	700961793H1	SOYMON022	g567102	BLASTX	119	1e-9	50
6369	20486	700726640H1	SOYMON009	g567102	BLASTX	131	1e-16	75
6370	24418	700605382H2	SOYMON004	g914914	BLASTN	814	1e-59	76
6371	24418	701052653H1	SOYMON032	g567101	BLASTN	760	1e-54	79
6372	24418	700847843H1	SOYMON021	g567101	BLASTN	447	1e-50	82
6373	24418	701051337H1	SOYMON032	g914914	BLASTN	715	1e-50	78
6374	24418	700656509H1	SOYMON004	g914914	BLASTN	655	1e-45	72
6375	24418	701101473H1	SOYMON028	g567101	BLASTN	417	1e-43	80
6376	24418	701053551H1	SOYMON032	g607752	BLASTX	126	1e-14	72
6377	26845	701046671H1	SOYMON032	g567101	BLASTN	528	1e-35	67
6378	26845	701103555H1	SOYMON028	g607751	BLASTN	352	1e-18	63
6379	-GM20322	LIB3056-013-Q1-N1-F3	LIB3056	g567101	BLASTN	766	1e-53	81
6380	-GM36301	LIB3051-054-Q1-K1-G11	LIB3051	g607751	BLASTN	273	1e-11	91
6381	-GM37519	LIB3051-063-Q1-K1-D7	LIB3051	g567101	BLASTN	911	1e-67	81
6382	11698	LIB3051-065-Q1-K1-G9	LIB3051	g567102	BLASTX	167	1e-32	58
6383	12737	LIB3051-003-Q1-E1-C4	LIB3051	g567101	BLASTN	820	1e-58	75
6384	24418	LIB3051-104-Q1-K1-G11	LIB3051	g914914	BLASTN	1096	1e-89	77
6385	24418	LIB3051-042-Q1-K1-C1	LIB3051	g567101	BLASTN	1019	1e-84	78
6386	24418	LIB3051-116-Q1-K1-B4	LIB3051	g914914	BLASTN	918	1e-67	73
6387	24418	LIB3051-046-Q1-K1-E11	LIB3051	g914914	BLASTN	863	1e-65	76

# SOYBEAN PUTATIVE PEP CARBOXYKINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Id
6388	-700868431	700868431H1	SOYMON016	g2827717	BLASTX	94	1e-9	81

# MAIZE PYRUVATE, PHOSPHATE DIKINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6389	-700044189	700044189H1	SATMON004	g168579	BLASTN	155	1e-10	89
6390	-700098830	700098830H1	SATMON009	g257804	BLASTN	317	1e-76	93
6391	-700267212	700267212H1	SATMON017	g168579	BLASTN	1115	1e-84	86
6392	-700268101	700268101H1	SATMON017	g257809	BLASTN	698	1e-66	96
6393	-700404827	700404827H1	SATMON026	g168583	BLASTN	445	1e-57	89
6394	-700426407	700426407H1	SATMONN01	g168579	BLASTN	365	1e-21	81
6395	-700430716	700430716H1	SATMONN01	g22451	BLASTN	210	1e-8	83
6396	-700438208	700438208H1	SATMON026	g168584	BLASTN	325	1e-50	94
6397	-700438250	700438250H1	SATMON026	g168579	BLASTN	263	1e-28	94
6398	-700442440	700442440H1	SATMON026	g168579	BLASTN	492	1e-63	84
6399	-700442486	700442486H1	SATMON026	g168579	BLASTN	399	1e-34	76
6400	-700442534	700442534H1	SATMON026	g168579	BLASTN	280	1e-26	86



6401	-700445755	700445755H1	SATMON027	g168579	BLASTN	537	1e-45	91
6402	-700448312	700448312H1	SATMON027	g168579	BLASTN	201	1e-16	93
6403	-700458259	700458259H1	SATMON029	g168579	BLASTN	635	1e-57	87
6404	-700460850	700460850H1	SATMON031	g168579	BLASTN	227	1e-14	92
6405	-700576979	700576979H1	SATMON031	g168579	BLASTN	239	1e-9	89
6406	-700582461	700582461H1	SATMON031	g168584	BLASTN	310	1e-34	86
6407	-700613790	700613790H1	SATMON033	g168579	BLASTN	473	1e-69	90
6408	-700615033	700615033H1	SATMON033	g168579	BLASTN	1209	1e-94	89
6409	-700807115	700807115H1	SATMON036	g168579	BLASTN	961	1e-71	85
6410	-700807148	700807148H1	SATMON036	g168579	BLASTN	1046	1e-78	85
6411	-700807285	700807285H1	SATMON036	g168579	BLASTN	850	1e-61	81
6412	241	700616008H1	SATMON033	g168579	BLASTN	1750	1e-136	99
6413	241	700084360H1	SATMON011	g168579	BLASTN	1706	1e-133	99
6414	241	700097569H1	SATMON009	g168579	BLASTN	1635	1e-127	100
6415	241	700099686H1	SATMON009	g168579	BLASTN	1540	1e-124	100
6416	241	700097065H1	SATMON009	g168579	BLASTN	1565	1e-124	100
6417	241	700097577H1	SATMON009	g168579	BLASTN	1601	1e-124	99
6418	241	700098157H1	SATMON009	g168579	BLASTN	1588	1e-123	99
6419	241	700095354H1	SATMON008	g168579	BLASTN	1578	1e-122	99
6420	241	700097024H1	SATMON009	g168579	BLASTN	1561	1e-121	98
6421	241	700101705H1	SATMON009	g168579	BLASTN	1563	1e-121	99
6422	241	700100753H1	SATMON009	g168579	BLASTN	1569	1e-121	98
6423	241	700209526H1	SATMON016	g168579	BLASTN	1548	1e-120	98
6424	241	700101967H1	SATMON009	g168579	BLASTN	1550	1e-120	100
6425	241	700100971H1	SATMON009	g168579	BLASTN	1552	1e-120	97
6426	241	700097028H1	SATMON009	g168579	BLASTN	876	1e-119	99
6427	241	700100216H1	SATMON009	g168579	BLASTN	1068	1e-118	98
6428	241	700100408H1	SATMON009	g168579	BLASTN	1413	1e-118	99
6429	241	700098443H1	SATMON009	g168579	BLASTN	1518	1e-117	99
6430	241	700099779H1	SATMON009	g168579	BLASTN	1502	1e-116	97
6431	241	700099086H1	SATMON009	g168579	BLASTN	1503	1e-116	99
6432	241	700101887H1	SATMON009	g168579	BLASTN	1506	1e-116	99
6433	241	700097164H1	SATMON009	g168579	BLASTN	1489	1e-115	98
6434	241	700100751H1	SATMON009	g168579	BLASTN	1492	1e-115	97
6435	241	700101890H1	SATMON009	g168579	BLASTN	1498	1e-115	99
6436	241	700100212H1	SATMON009	g168579	BLASTN	1042	1e-114	99
6437	241	700100040H1	SATMON009	g168579	BLASTN	1484	1e-114	99
6438	241	700101179H1	SATMON009	g168579	BLASTN	1486	1e-114	99
6439	241	700097777H1	SATMON009	g168579	BLASTN	1097	1e-113	97
6440	241	700621494H1	SATMON034	g168579	BLASTN	1184	1e-113	97
6441	241	700621492H1	SATMON034	g168579	BLASTN	1184	1e-113	97
6442	241	700620055H1	SATMON034	g168579	BLASTN	1205	1e-113	98
6443	241	700099278H1	SATMON009	g168579	BLASTN	1468	1e-113	99
6444	241	700100235H1	SATMON009	g168579	BLASTN	1036	1e-112	97
6445	241	700097726H1	SATMON009	g168579	BLASTN	1452	1e-112	99
6446	241	700099458H1	SATMON009	g168579	BLASTN	1452	1e-112	97
6447	241	700101405H1	SATMON009	g168579	BLASTN	1457	1e-112	99
6448	241	700098006H1	SATMON009	g168579	BLASTN	1458	1e-112	98
6449	241	700098988H1	SATMON009	g168579	BLASTN	1460	1e-112	98
6450	241	700101193H1	SATMON009	g168579	BLASTN	1460	1e-112	100
6451	241	700099029H1	SATMON009	g168579	BLASTN	1450	1e-111	100
6452	241	700099494H1	SATMON009	g168579	BLASTN	1451	1e-111	99
6453	241	700624034H1	SATMON034	g168579	BLASTN	887	1e-110	92
6454	241	700099587H1	SATMON009	g168579	BLASTN	1432	1e-110	97

6455	241	700097537H1	SATMON009	g168579	BLASTN	1434	1e-110	98
6456	241	700099280H1	SATMON009	g168579	BLASTN	1437	1e-110	98
6457	241	700099242H1	SATMON009	g168579	BLASTN	924	1e-109	98
6458	241	700097259H1	SATMON009	g168579	BLASTN	1275	1e-109	98
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6460	241	700097672H1	SATMON009	g168579	BLASTN	1425	1e-109	95
6461	241	700099985H1	SATMON009	g168579	BLASTN	870	1e-108	99
6462	241	700045762H1	SATMON004	g168579	BLASTN	1410	1e-108	100
6463	241	700101542H1	SATMON009	g168579	BLASTN	1008	1e-107	98
6464	241	700099788H1	SATMON009	g168579	BLASTN	1255	1e-107	99
6465	241	700265183H1	SATMON017	g168579	BLASTN	1394	1e-107	97
6466	241	700072495H1	SATMON007	g168579	BLASTN	1395	1e-107	96
6467	241	700578123H1	SATMON031	g168579	BLASTN	1398	1e-107	98
6468	241	700445628H1	SATMON027	g168579	BLASTN	1401	1e-107	96
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6473	241	700042861H1	SATMON004	g168579	BLASTN	1387	1e-106	99
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6475	241	700213650H1	SATMON016	g168579	BLASTN	1367	1e-105	99
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6477	241	700441931H1	SATMON026	g168579	BLASTN	1370	1e-105	98
6478	241	700097944H1	SATMON009	g168579	BLASTN	1372	1e-105	97
6479	241	700423208H1	SATMONN01	g168579	BLASTN	630	1e-104	97
6480	241	700442667H1	SATMON026	g168579	BLASTN	1259	1e-104	98
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6482	241	700208177H1	SATMON016	g168579	BLASTN	1365	1e-104	97
6483	241	700444555H1	SATMON027	g168579	BLASTN	1227	1e-103	99
6484	241	700580211H1	SATMON031	g168579	BLASTN	1238	1e-103	99
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6495	241	700442593H1	SATMON026	g168579	BLASTN	1338	1e-102	99
6496	241	700581301H1	SATMON031	g168579	BLASTN	1338	1e-102	98
6497	241	700043360H1	SATMON004	g168579	BLASTN	1340	1e-102	100
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6511	241	700802781H1	SATMON036	g168579	BLASTN	1307	1e-100	99
6512	241	700045313H1	SATMON004	g168579	BLASTN	1316	1e-100	99
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6514	241	700440018H1	SATMON026	g168579	BLASTN	1317	1e-100	99
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6522	241	700578928H1	SATMON031	g168579	BLASTN	1303	1e-99	99
6523	241	700467315H1	SATMON025	g168579	BLASTN	490	1e-98	98
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6525	241	700801426H1	SATMON036	g168579	BLASTN	1256	1e-98	99
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6527	241	700043365H1	SATMON004	g168579	BLASTN	1294	1e-98	98
6528	241	700042742H1	SATMON004	g168579	BLASTN	1294	1e-98	97
6529	241	700041509H1	SATMON004	g168579	BLASTN	870	1e-97	99
6530	241	700098536H1	SATMON009	g168584	BLASTN	910	1e-97	97
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6532	241	700578290H1	SATMON031	g168579	BLASTN	1232	1e-97	99
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6534	241	700043494H1	SATMON004	g168579	BLASTN	1275	1e-97	97
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6537	241	700041517H1	SATMON004	g168579	BLASTN	1281	1e-97	96
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6539	241	700456453H1	SATMON029	g168579	BLASTN	669	1e-96	97
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6541	241	700042888H1	SATMON004	g168579	BLASTN	1172	1e-96	99
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6546	241	700434549H1	SATMONN01	g168579	BLASTN	1269	1e-96	91
6547	241	700433527H1	SATMONN01	g168579	BLASTN	795	1e-95	99
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6549	241	700440442H1	SATMON026	g168579	BLASTN	997	1e-95	97
6550	241	700432310H1	SATMONN01	g168579	BLASTN	1074	1e-95	97
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6552	241	700043320H1	SATMON004	g168579	BLASTN	1129	1e-95	98
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6554	241	700441415H1	SATMON026	g168579	BLASTN	580	1e-94	96
6555	241	700460762H1	SATMON031	g168579	BLASTN	624	1e-94	97
6556	241	700053387H1	SATMON009	g168584	BLASTN	649	1e-94	96
6557	241	700044829H1	SATMON004	g168579	BLASTN	960	1e-94	100
6558	241	700576848H1	SATMON031	g168579	BLASTN	1207	1e-94	98
6559	241	700195073H1	SATMON014	g168579	BLASTN	1245	1e-94	98
6560	241	700044956H1	SATMON004	g168579	BLASTN	1246	1e-94	97
6561	241	700441974H1	SATMON026	g168579	BLASTN	588	1e-93	97
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6563	241	700584010H1	SATMON031	g168579	BLASTN	753	1e-93	92
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6568	241	700438416H1	SATMON026	g168579	BLASTN	1013	1e-92	97
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6570	241	700433859H1	SATMONN01	g168579	BLASTN	1148	1e-92	96
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6572	241	700208040H1	SATMON016	g168579	BLASTN	1171	1e-92	98
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6577	241	700044111H1	SATMON004	g168579	BLASTN	700	1e-91	98
6578	241	700576815H1	SATMON031	g168579	BLASTN	912	1e-91	96
6579	241	700438522H1	SATMON026	g168579	BLASTN	1105	1e-91	97
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6584	241	700578265H1	SATMON031	g168579	BLASTN	1074	1e-90	98
6585	241	700442849H1	SATMON026	g168579	BLASTN	891	1e-89	94
6586	241	700044381H1	SATMON004	g168579	BLASTN	1033	1e-89	95
6587	241	700578031H1	SATMON031	g168579	BLASTN	1175	1e-89	96
6588	241	700802158H1	SATMON036	g168579	BLASTN	1183	1e-89	91
6589	241	700581537H1	SATMON031	g168579	BLASTN	434	1e-88	97
6590	241	700447772H1	SATMON027	g168579	BLASTN	628	1e-88	96
6591	241	700044908H1	SATMON004	g168579	BLASTN	1166	1e-88	97
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6593	241	700580766H1	SATMON031	g168579	BLASTN	1168	1e-88	98
6594	241	700100482H1	SATMON009	g168579	BLASTN	1169	1e-88	87
6595	241	700428285H1	SATMONN01	g168579	BLASTN	707	1e-87	97
6596	241	700158124H1	SATMON012	g168579	BLASTN	918	1e-87	98
6597	241	700439158H1	SATMON026	g168579	BLASTN	922	1e-87	93
6598	241	700577046H1	SATMON031	g168579	BLASTN	989	1e-87	97
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6600	241	700099229H1	SATMON009	g168579	BLASTN	1154	1e-87	98
6601	241	700045027H1	SATMON004	g168579	BLASTN	1162	1e-87	97
6602	241	701177010H1	SATMONN05	g22452	BLASTN	413	1e-86	94
6603	241	700044687H1	SATMON004	g168579	BLASTN	660	1e-86	99
6604	241	700438501H1	SATMON026	g168579	BLASTN	714	1e-86	95
6605	241	700044229H1	SATMON004	g168579	BLASTN	965	1e-86	100
6606	241	700447355H1	SATMON027	g168579	BLASTN	1074	1e-86	96
6607	241	700806248H1	SATMON036	g168579	BLASTN	1082	1e-86	96
6608	241	700044220H1	SATMON004	g168579	BLASTN	1132	1e-85	97
6609	241	700193031H1	SATMON014	g168579	BLASTN	1121	1e-84	92
6610	241	700581571H1	SATMON031	g168584	BLASTN	461	1e-83	95
6611	241	700100987H1	SATMON009	g168579	BLASTN	1006	1e-83	93
6612	241	700439748H1	SATMON026	g168579	BLASTN	1107	1e-83	97
6613	241	700441474H1	SATMON026	g168579	BLASTN	570	1e-82	96
6614	241	700042302H1	SATMON004	g168579	BLASTN	586	1e-82	98
6615	241	700616327H1	SATMON033	g168579	BLASTN	604	1e-82	88
6616	241	700194736H1	SATMON014	g168584	BLASTN	625	1e-82	96

6617	241	700578367H1	SATMON031	g168579	BLASTN	674	1e-82	96
6618	241	700042652H1	SATMON004	g168579	BLASTN	693	1e-82	98
6619	241	700397564H1	SATMONN01	g168579	BLASTN	965	1e-82	89
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6621	241	700429519H1	SATMONN01	g168579	BLASTN	1098	1e-82	89
6622	241	700438174H1	SATMON026	g168579	BLASTN	1102	1e-82	90
6623	241	700583672H1	SATMON031	g168579	BLASTN	894	1e-81	88
6624	241	700441307H1	SATMON026	g168579	BLASTN	1088	1e-81	99
6625	241	701176710H1	SATMONN05	g22452	BLASTN	477	1e-79	94
6626	241	700581577H1	SATMON031	g168579	BLASTN	551	1e-79	94
6627	241	700428336H1	SATMONN01	g168579	BLASTN	948	1e-79	92
6628	241	700018165H1	SATMON001	g168579	BLASTN	1020	1e-79	98
6629	241	700405414H1	SATMON029	g168579	BLASTN	1058	1e-79	98
6630	241	700239413H1	SATMON010	g168579	BLASTN	965	1e-78	95
6631	241	700581594H1	SATMON031	g168579	BLASTN	607	1e-76	89
6632	241	700433062H1	SATMONN01	g168579	BLASTN	642	1e-76	85
6633	241	700581979H1	SATMON031	g168579	BLASTN	1019	1e-76	85
6634	241	700441332H1	SATMON026	g168579	BLASTN	1023	1e-76	94
6635	241	700441363H1	SATMON026	g168579	BLASTN	1016	1e-75	94
6636	241	700807116H1	SATMON036	g168581	BLASTN	686	1e-74	99
6637	241	700800557H1	SATMON036	g168579	BLASTN	985	1e-73	86
6638	241	700803903H1	SATMON036	g168579	BLASTN	391	1e-72	87
6639	241	700257764H1	SATMON017	g168579	BLASTN	974	1e-72	94
6640	241	700207392H1	SATMON016	g168579	BLASTN	960	1e-71	100
6641	241	700193933H1	SATMON014	g168579	BLASTN	969	1e-71	88
6642	241	700806409H1	SATMON036	g168581	BLASTN	543	1e-69	96
6643	241	700195405H1	SATMON014	g168579	BLASTN	740	1e-69	87
6644	241	700579292H1	SATMON031	g168579	BLASTN	746	1e-69	94
6645	241	700427458H1	SATMONN01	g168584	BLASTN	337	1e-68	88
6646	241	700624196H1	SATMON034	g168579	BLASTN	648	1e-66	90
6647	241	700805096H1	SATMON036	g168579	BLASTN	900	1e-66	86
6648	241	700042161H1	SATMON004	g168579	BLASTN	903	1e-66	91
6649	241	700578768H1	SATMON031	g168584	BLASTN	908	1e-66	93
6650	241	700802865H1	SATMON036	g168584	BLASTN	705	1e-65	94
6651	241	700580152H1	SATMON031	g168579	BLASTN	863	1e-63	96
6652	241	700041938H1	SATMON004	g168584	BLASTN	845	1e-61	100
6653	241	700196549H1	SATMON014	g168579	BLASTN	848	1e-61	91
6654	241	700425162H1	SATMONN01	g22451	BLASTN	805	1e-60	100
6655	241	701160579H1	SATMONN04	g168579	BLASTN	380	1e-59	96
6656	241	700456514H1	SATMON029	g168579	BLASTN	822	1e-59	92
6657	241	700441507H1	SATMON026	g168579	BLASTN	697	1e-58	96
6658	241	700099603H1	SATMON009	g168579	BLASTN	804	1e-58	98
6659	241	700442758H1	SATMON026	g168579	BLASTN	326	1e-56	90
6660	241	700804296H1	SATMON036	g168579	BLASTN	687	1e-54	84
6661	241	700438664H1	SATMON026	g168579	BLASTN	277	1e-53	96
6662	241	700441510H1	SATMON026	g168579	BLASTN	388	1e-52	96
6663	241	700428514H1	SATMONN01	g168579	BLASTN	491	1e-52	96
6664	241	700101932H1	SATMON009	g168579	BLASTN	384	1e-50	92
6665	241	700262656H1	SATMON017	g168579	BLASTN	542	1e-49	93
6666	241	700583279H1	SATMON031	g168579	BLASTN	449	1e-47	95
6667	241	700624652H1	SATMON034	g168579	BLASTN	623	1e-47	96
6668	241	700612451H1	SATMON033	g168579	BLASTN	672	1e-47	89
6669	241	700335324H1	SATMON019	g168581	BLASTN	637	1e-46	71
6670	241	700440390H1	SATMON026	g168579	BLASTN	361	1e-45	95

6671	241	700097825H1	SATMON009	g168579	BLASTN	650	1e-45	100
6672	241	701163821H1	SATMONN04	g168581	BLASTN	606	1e-44	98
6673	241	700438560H1	SATMON026	g168584	BLASTN	623	1e-43	96
6674	241	700805587H1	SATMON036	g168579	BLASTN	632	1e-43	84
6675	241	700100859H1	SATMON009	g168579	BLASTN	612	1e-42	97
6676	241	700580595H1	SATMON031	g168579	BLASTN	295	1e-39	81
6677	241	700441529H1	SATMON026	g168584	BLASTN	302	1e-37	97
6678	241	700045548H1	SATMON004	g22451	BLASTN	511	1e-36	99
6679	241	700097365H1	SATMON009	g168579	BLASTN	544	1e-36	97
6680	241	700424468H1	SATMONN01	g168579	BLASTN	547	1e-36	94
6681	241	700457633H1	SATMON029	g168584	BLASTN	275	1e-35	96
6682	241	700425102H1	SATMONN01	g168579	BLASTN	472	1e-33	92
6683	241	700097811H1	SATMON009	g168579	BLASTN	501	1e-32	87
6684	241	700404795H1	SATMON026	g168584	BLASTN	483	1e-31	98
6685	241	700431218H1	SATMONN01	g168579	BLASTN	302	1e-29	96
6686	241	700097835H1	SATMON009	g168579	BLASTN	337	1e-29	89
6687	241	700100627H1	SATMON009	g168579	BLASTN	444	1e-28	94
6688	241	700618263H1	SATMON033	g168579	BLASTN	286	1e-27	88
6689	241	700583801H1	SATMON031	g168579	BLASTN	350	1e-26	95
6690	241	700099807H1	SATMON009	g168579	BLASTN	233	1e-24	94
6691	241	700097573H1	SATMON009	g168579	BLASTN	305	1e-23	92
6692	241	700427553H1	SATMONN01	g168584	BLASTN	344	1e-23	93
6693	241	700098562H1	SATMON009	g168579	BLASTN	309	1e-16	95
6694	241	700799964H1	SATMON036	g168584	BLASTN	234	1e-13	94
6695	3862	700266534H1	SATMON017	g257804	BLASTN	923	1e-77	97
6696	3862	700455813H1	SATMON029	g257804	BLASTN	879	1e-66	98
6697	3862	700099255H1	SATMON009	g168579	BLASTN	460	1e-29	91
6698	5767	700098424H1	SATMON009	g22449	BLASTN	1555	1e-120	98
6699	5767	700099971H1	SATMON009	g168583	BLASTN	1468	1e-113	96
6700	5767	700044869H1	SATMON004	g168583	BLASTN	1242	1e-99	98
6701	5767	700097037H1	SATMON009	g168579	BLASTN	1264	1e-96	89
6702	5767	700095363H1	SATMON008	g168583	BLASTN	310	1e-78	97
6703	5767	700101364H1	SATMON009	g22449	BLASTN	1006	1e-75	94
6704	5767	700101568H1	SATMON009	g22449	BLASTN	1013	1e-75	95
6705	5767	700045180H1	SATMON004	g22449	BLASTN	901	1e-74	90
6706	5767	700042559H1	SATMON004	g22449	BLASTN	998	1e-74	94
6707	5767	700045393H1	SATMON004	g22449	BLASTN	865	1e-63	100
6708	5767	700099658H1	SATMON009	g22449	BLASTN	531	1e-35	92
6709	-L1433809	LIB143-024-Q1-E1-F11	LIB143	g168579	BLASTN	256	1e-23	81
6710	-L30592709	LIB3059-017-Q1-K1-F2	LIB3059	g2443401	BLASTN	431	1e-27	68
6711	-L30593789	LIB3059-022-Q1-K1-D6	LIB3059	g168584	BLASTN	361	1e-21	89
6712	-L30594314	LIB3059-032-Q1-K1-G4	LIB3059	g168579	BLASTN	488	1e-29	63
6713	-L30594987	LIB3059-056-Q1-K1-G11	LIB3059	g168579	BLASTN	406	1e-41	73
6714	-L30596613	LIB3059-054-Q1-K1-F4	LIB3059	g168579	BLASTN	568	1e-52	78
6715	-L30602598	LIB3060-018-Q1-K1-B4	LIB3060	g168579	BLASTN	580	1e-79	73
6716	-L30602793	LIB3060-014-Q1-K1-C6	LIB3060	g168583	BLASTN	513	1e-62	77

6717	-L30602820	LIB3060-017-Q1-K1-B1	LIB3060	g168579	BLASTN	151	1e-12	89
6718	-L30603538	LIB3060-045-Q1-K1-E12	LIB3060	g168583	BLASTN	382	1e-34	88
6719	-L30603998	LIB3060-036-Q1-K1-H4	LIB3060	g168579	BLASTN	678	1e-90	82
6720	-L30605229	LIB3060-050-Q1-K1-D5	LIB3060	g168579	BLASTN	305	1e-16	80
6721	-L30611520	LIB3061-002-Q1-K2-D12	LIB3061	g168581	BLASTN	492	1e-41	82
6722	-L30615750	LIB3061-042-Q1-K1-H11	LIB3061	g168579	BLASTN	223	1e-11	96
6723	-L30783291	LIB3078-051-Q1-K1-G3	LIB3078	g168579	BLASTN	538	1e-70	73
6724	-L30784553	LIB3078-011-Q1-K1-B7	LIB3078	g168579	BLASTN	671	1e-90	83
6725	-L361816	LIB36-020-Q1-E1-A10	LIB36	g168579	BLASTN	738	1e-69	82
6726	-L362168	LIB36-005-Q1-E1-D11	LIB36	g168579	BLASTN	304	1e-15	72
6727	-L362639	LIB36-007-Q1-E1-F2	LIB36	g168584	BLASTN	332	1e-36	86
6728	-L831870	LIB83-009-Q1-E1-E9	LIB83	g168579	BLASTN	250	1e-11	100
6729	-L831984	LIB83-010-Q1-E1-B1	LIB83	g168584	BLASTN	382	1e-41	89
6730	241	LIB36-016-Q2-E2-E10	LIB36	g168579	BLASTN	2261	1e-179	99
6731	241	LIB3060-003-Q1-K1-C3	LIB3060	g168579	BLASTN	2186	1e-173	99
6732	241	LIB3078-052-Q1-K1-H5	LIB3078	g168579	BLASTN	2188	1e-173	99
6733	241	LIB3078-033-Q1-K1-A12	LIB3078	g168579	BLASTN	2176	1e-172	98
6734	241	LIB36-016-Q2-E2-C3	LIB36	g168579	BLASTN	2164	1e-171	98
6735	241	LIB3060-054-Q1-K1-E4	LIB3060	g168579	BLASTN	1973	1e-168	97
6736	241	LIB36-016-Q2-E2-C5	LIB36	g168579	BLASTN	2130	1e-168	98
6737	241	LIB36-014-Q1-E1-D2	LIB36	g168579	BLASTN	1968	1e-167	96
6738	241	LIB3059-058-Q1-K1-A12	LIB3059	g168579	BLASTN	2112	1e-167	98
6739	241	LIB3060-006-Q1-K1-C1	LIB3060	g168579	BLASTN	1699	1e-165	97
6740	241	LIB3060-016-Q1-K1-F8	LIB3060	g168579	BLASTN	2051	1e-165	99
6741	241	LIB3060-045-Q1-K1-E3	LIB3060	g168579	BLASTN	2098	1e-165	97
6742	241	LIB3060-026-Q1-K1-D6	LIB3060	g168579	BLASTN	1162	1e-164	94
6743	241	LIB3060-012-Q1-K1-A7	LIB3060	g168579	BLASTN	1897	1e-164	98

6744	241	LIB83-003-Q1-E1-G2	LIB83	g168579	BLASTN	2077	1e-164	96
6745	241	LIB143-022-Q1-E1-G5	LIB143	g168579	BLASTN	2087	1e-164	98
6746	241	LIB3060-044-Q1-K1-F6	LIB3060	g168579	BLASTN	1768	1e-163	95
6747	241	LIB3060-025-Q1-K1-B10	LIB3060	g168579	BLASTN	2058	1e-162	96
6748	241	LIB36-005-Q1-E1-C7	LIB36	g168579	BLASTN	2059	1e-162	97
6749	241	LIB3060-052-Q1-K1-D5	LIB3060	g168579	BLASTN	1831	1e-161	97
6750	241	LIB3059-024-Q1-K1-F6	LIB3059	g168579	BLASTN	1932	1e-161	99
6751	241	LIB36-002-Q1-E1-B10	LIB36	g168579	BLASTN	2051	1e-161	98
6752	241	LIB3060-052-Q1-K1-E8	LIB3060	g168579	BLASTN	1740	1e-160	97
6753	241	LIB3060-016-Q1-K1-G8	LIB3060	g168579	BLASTN	2030	1e-160	97
6754	241	LIB84-004-Q1-E1-C3	LIB84	g168579	BLASTN	2034	1e-160	97
6755	241	LIB3060-051-Q1-K1-E9	LIB3060	g168579	BLASTN	2037	1e-160	98
6756	241	LIB84-013-Q1-E1-A5	LIB84	g168579	BLASTN	2018	1e-159	98
6757	241	LIB3078-002-Q1-K1-E2	LIB3078	g168579	BLASTN	2027	1e-159	97
6758	241	LIB189-006-Q1-E1-G6	LIB189	g168579	BLASTN	1791	1e-158	99
6759	241	LIB3060-044-Q1-K1-F8	LIB3060	g168579	BLASTN	1692	1e-157	98
6760	241	LIB36-004-Q1-E1-B11	LIB36	g168579	BLASTN	1892	1e-157	98
6761	241	LIB3078-013-Q1-K1-H10	LIB3078	g168579	BLASTN	1853	1e-156	97
6762	241	LIB36-015-Q1-E1-F9	LIB36	g168579	BLASTN	1988	1e-156	98
6763	241	LIB189-020-Q1-E1-G9	LIB189	g168579	BLASTN	1972	1e-155	98
6764	241	LIB36-004-Q1-E1-F10	LIB36	g168579	BLASTN	1972	1e-155	99
6765	241	LIB3060-005-Q1-K1-B6	LIB3060	g168579	BLASTN	1974	1e-155	99
6766	241	LIB3060-052-Q1-K1-H7	LIB3060	g168579	BLASTN	1979	1e-155	94
6767	241	LIB189-007-Q1-E1-G11	LIB189	g168579	BLASTN	1130	1e-154	99
6768	241	LIB83-006-Q1-E1-C7	LIB83	g168579	BLASTN	1964	1e-154	98
6769	241	LIB189-009-Q1-E1-G9	LIB189	g168579	BLASTN	1405	1e-150	97
6770	241	LIB3060-036-Q1-K1-H3	LIB3060	g168579	BLASTN	1910	1e-150	94



6771	241	LIB189-013-Q1-E1-D10	LIB189	g168579	BLASTN	1732	1e-149	93
6772	241	LIB36-014-Q1-E1-D12	LIB36	g168579	BLASTN	1519	1e-147	95
6773	241	LIB3078-055-Q1-K1-E2	LIB3078	g168579	BLASTN	1860	1e-146	90
6774	241	LIB3060-004-Q1-K1-D9	LIB3060	g168579	BLASTN	1830	1e-143	97
6775	241	LIB189-020-Q1-E1-G4	LIB189	g168579	BLASTN	1823	1e-142	92
6776	241	LIB3060-008-Q1-K1-D10	LIB3060	g168579	BLASTN	1511	1e-140	90
6777	241	LIB189-008-Q1-E1-B5	LIB189	g168579	BLASTN	1379	1e-139	95
6778	241	LIB3059-040-Q1-K1-E1	LIB3059	g168579	BLASTN	1437	1e-139	91
6779	241	LIB3078-051-Q1-K1-G2	LIB3078	g168579	BLASTN	1474	1e-139	96
6780	241	LIB84-029-Q1-E1-E6	LIB84	g168579	BLASTN	1508	1e-136	98
6781	241	LIB36-004-Q1-E1-D1	LIB36	g168579	BLASTN	1310	1e-134	94
6782	241	LIB3059-012-Q1-K1-D10	LIB3059	g168579	BLASTN	1720	1e-134	89
6783	241	LIB3059-044-Q1-K1-E2	LIB3059	g168579	BLASTN	1725	1e-134	87
6784	241	LIB3059-043-Q1-K1-F7	LIB3059	g168579	BLASTN	1588	1e-133	87
6785	241	LIB189-008-Q1-E1-H1	LIB189	g168579	BLASTN	1705	1e-133	91
6786	241	LIB83-003-Q1-E1-D3	LIB83	g168579	BLASTN	1422	1e-131	97
6787	241	LIB189-002-Q1-E1-C11	LIB189	g168579	BLASTN	1656	1e-131	97
6788	241	LIB36-002-Q1-E1-F3	LIB36	g168579	BLASTN	1546	1e-129	96
6789	241	LIB189-015-Q1-E1-F3	LIB189	g168579	BLASTN	1062	1e-127	94
6790	241	LIB189-013-Q1-E1-F6	LIB189	g168579	BLASTN	1639	1e-127	97
6791	241	LIB3061-007-Q1-K1-A1	LIB3061	g168579	BLASTN	1625	1e-126	85
6792	241	LIB3060-054-Q1-K1-D4	LIB3060	g168579	BLASTN	879	1e-123	89
6793	241	LIB3078-028-Q1-K1-A6	LIB3078	g168579	BLASTN	1066	1e-123	93
6794	241	LIB3059-047-Q1-K1-H7	LIB3059	g168579	BLASTN	1576	1e-122	85
6795	241	LIB36-021-Q1-E1-F1	LIB36	g168579	BLASTN	1465	1e-121	100
6796	241	LIB3059-002-Q1-K2-A4	LIB3059	g168579	BLASTN	1273	1e-119	81
6797	241	LIB189-015-Q1-E1-G8	LIB189	g168579	BLASTN	1530	1e-118	94

6798	241	LIB189-007-Q1-E1-F9	LIB189	g168579	BLASTN	1517	1e-117	96
6799	241	LIB3079-013-Q1-K1-G8	LIB3079	g168579	BLASTN	1367	1e-115	90
6800	241	LIB36-015-Q1-E1-D2	LIB36	g168579	BLASTN	1333	1e-113	95
6801	241	LIB3059-018-Q1-K1-H2	LIB3059	g168579	BLASTN	1210	1e-112	86
6802	241	LIB3078-007-Q1-K1-E1	LIB3078	g168579	BLASTN	508	1e-111	90
6803	241	LIB3060-038-Q1-K1-H3	LIB3060	g168579	BLASTN	1443	1e-111	98
6804	241	LIB36-020-Q1-E1-A9	LIB36	g168579	BLASTN	1446	1e-111	95
6805	241	LIB3061-026-Q1-K1-D7	LIB3061	g168579	BLASTN	1435	1e-110	86
6806	241	LIB36-021-Q1-E1-G7	LIB36	g168579	BLASTN	1381	1e-109	96
6807	241	LIB3059-028-Q1-K1-G7	LIB3059	g168579	BLASTN	884	1e-108	88
6808	241	LIB189-029-Q1-E1-D4	LIB189	g168579	BLASTN	982	1e-108	87
6809	241	LIB3060-020-Q1-K1-F2	LIB3060	g168579	BLASTN	1053	1e-108	77
6810	241	LIB36-007-Q1-E1-E9	LIB36	g168579	BLASTN	1348	1e-108	94
6811	241	LIB3059-017-Q1-K1-C3	LIB3059	g168579	BLASTN	1096	1e-106	87
6812	241	LIB3061-051-Q1-K1-H5	LIB3061	g168581	BLASTN	931	1e-104	90
6813	241	LIB3061-009-Q1-K1-F12	LIB3061	g168579	BLASTN	1032	1e-102	76
6814	241	LIB3061-041-Q1-K1-C5	LIB3061	g168579	BLASTN	1326	1e-101	88
6815	241	LIB36-013-Q1-E1-B6	LIB36	g168579	BLASTN	1328	1e-101	91
6816	241	LIB84-016-Q1-E1-A7	LIB84	g168579	BLASTN	1308	1e-100	97
6817	241	LIB84-002-Q1-E1-D6	LIB84	g168579	BLASTN	716	1e-99	90
6818	241	LIB3060-039-Q1-K1-E5	LIB3060	g168579	BLASTN	1166	1e-99	92
6819	241	LIB3078-011-Q1-K1-E7	LIB3078	g168579	BLASTN	558	1e-95	84
6820	241	LIB3060-052-Q1-K1-H8	LIB3060	g168579	BLASTN	596	1e-95	89
6821	241	LIB3060-026-Q1-K1-D7	LIB3060	g168579	BLASTN	817	1e-94	82
6822	241	LIB3059-003-Q1-K1-F1	LIB3059	g168579	BLASTN	954	1e-93	86
6823	241	LIB189-006-Q1-E1-C4	LIB189	g22451	BLASTN	1136	1e-88	97
6824	241	LIB189-029-Q1-E1-C2	LIB189	g168579	BLASTN	746	1e-87	92

6825	241	LIB84-003-Q1-E1-C2	LIB84	g168584	BLASTN	1143	1e-86	99
6826	241	LIB36-014-Q1-E1-A2	LIB36	g168579	BLASTN	760	1e-83	97
6827	241	LIB3078-011-Q1-K1-D6	LIB3078	g22451	BLASTN	1085	1e-83	100
6828	241	LIB3059-031-Q1-K1-E3	LIB3059	g168581	BLASTN	914	1e-81	93
6829	241	LIB189-023-Q1-E1-E7	LIB189	g168581	BLASTN	755	1e-80	100
6830	241	LIB83-009-Q1-E1-D12	LIB83	g168579	BLASTN	1003	1e-74	92
6831	241	LIB83-010-Q1-E1-G9	LIB83	g168584	BLASTN	546	1e-65	98
6832	241	LIB189-017-Q1-E1-A5	LIB189	g22451	BLASTN	822	1e-61	93
6833	241	LIB3061-002-Q1-K1-D12	LIB3061	g168579	BLASTN	421	1e-57	87
6834	241	LIB3059-058-Q1-K1-A4	LIB3059	g168579	BLASTN	624	1e-55	86
6835	241	LIB3059-023-Q1-K1-C3	LIB3059	g168579	BLASTN	728	1e-51	85
6836	241	LIB189-027-Q1-E1-F4	LIB189	g168579	BLASTN	649	1e-49	87
6837	241	LIB3059-020-Q1-K1-E10	LIB3059	g22389	BLASTN	475	1e-48	91
6838	241	LIB3060-045-Q1-K1-H10	LIB3060	g168579	BLASTN	569	1e-47	89
6839	241	LIB84-003-Q1-E1-A10	LIB84	g22451	BLASTN	668	1e-47	90
6840	241	LIB3059-037-Q1-K1-H8	LIB3059	g22389	BLASTN	475	1e-35	91
6841	5767	LIB3060-051-Q1-K1-C1	LIB3060	g22449	BLASTN	1640	1e-164	99
6842	5767	LIB3060-015-Q1-K1-G11	LIB3060	g168583	BLASTN	1920	1e-162	99
6843	5767	LIB3060-017-Q1-K1-A8	LIB3060	g168583	BLASTN	2060	1e-162	100
6844	5767	LIB3060-014-Q1-K1-C3	LIB3060	g22449	BLASTN	1933	1e-159	97
6845	5767	LIB3060-010-Q1-K1-H5	LIB3060	g22449	BLASTN	1285	1e-156	99
6846	5767	LIB3060-045-Q1-K1-C7	LIB3060	g22449	BLASTN	1020	1e-76	95
6847	5767	LIB3060-027-Q1-K1-E7	LIB3060	g22449	BLASTN	1025	1e-76	95

## SOYBEAN PYRUVATE, PHOSPHATE DIKINASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6848	-700646607	700646607H1	SOYMON014	g18461	BLASTN	947	1e-70	81
6849	30854	700787466H2	SOYMON011	g577775	BLASTN	825	1e-59	80
6850	30854	LIB3054-008- Q1-N1-C5	LIB3054	g577775	BLASTN	1279	1e-97	80

# MAIZE PYROPHOSPHATASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
6851	-700043816	700043816H1	SATMON004	g1049254	BLASTN	476	1e-30	76
6852	-700049210	700049210H1	SATMON003	g1747293	BLASTN	216	1e-10	85
6853	-700098741	700098741H1	SATMON009	g1747293	BLASTN	1093	1e-82	85
6854	-700100718	700100718H1	SATMON009	g1747293	BLASTN	595	1e-40	86
6855	-700105040	700105040H1	SATMON010	g1747293	BLASTN	463	1e-28	76
6856	-700150777	700150777H1	SATMON007	g1747293	BLASTN	708	1e-50	89
6857	-700155610	700155610H1	SATMON007	g1049254	BLASTN	311	1e-15	64
6858	-700163331	700163331H1	SATMON013	g534915	BLASTN	751	1e-53	77
6859	-700171438	700171438H1	SATMON013	g2258073	BLASTN	256	1e-10	76
6860	-700193866	700193866H1	SATMON014	g166633	BLASTN	494	1e-32	64
6861	-700202576	700202576H1	SATMON003	g2668746	BLASTX	214	1e-23	84
6862	-700206487	700206487H1	SATMON003	g2570501	BLASTX	174	1e-17	86
6863	-700216624	700216624H1	SATMON016	g1747293	BLASTN	936	1e-82	84
6864	-700217292	700217292H1	SATMON016	g2668746	BLASTX	214	1e-23	100
6865	-700240889	700240889H1	SATMON010	g2570500	BLASTN	639	1e-47	84
6866	-700242309	700242309H1	SATMON010	g1747293	BLASTN	621	1e-42	69
6867	-700347658	700347658H1	SATMON023	g2668746	BLASTX	215	1e-23	95
6868	-700349391	700349391H1	SATMON023	g1049255	BLASTX	174	1e-17	52
6869	-700427206	700427206H1	SATMONN01	g1049254	BLASTN	292	1e-33	90
6870	-700451045	700451045H1	SATMON028	g1049255	BLASTX	55	1e-10	72
6871	-700454151	700454151H1	SATMON029	g2668745	BLASTN	172	1e-10	90
6872	-700454532	700454532H1	SATMON029	g2668745	BLASTN	259	1e-38	93
6873	-700475488	700475488H1	SATMON025	g1747293	BLASTN	1126	1e-84	90
6874	-700552133	700552133H1	SATMON022	g457744	BLASTX	176	1e-19	68
6875	-700571086	700571086H1	SATMON030	g1747293	BLASTN	1429	1e-110	88
6876	-700572341	700572341H1	SATMON030	g1747293	BLASTN	475	1e-70	89
6877	-700611864	700611864H1	SATMON022	g2668745	BLASTN	203	1e-9	84
6878	-701166871	701166871H1	SATMONN04	g1049255	BLASTX	105	1e-13	72
6879	107	700622451H1	SATMON034	g2668745	BLASTN	1645	1e-129	100
6880	107	700571235H1	SATMON030	g2668745	BLASTN	1406	1e-125	98
6881	107	700266126H1	SATMON017	g2668745	BLASTN	1145	1e-121	100
6882	107	700621607H1	SATMON034	g2668745	BLASTN	1375	1e-121	99
6883	107	700345080H1	SATMON021	g2668745	BLASTN	1195	1e-117	100
6884	107	700624257H1	SATMON034	g2668745	BLASTN	825	1e-115	100
6885	107	700030359H1	SATMON003	g2668745	BLASTN	1470	1e-114	100
6886	107	700214462H1	SATMON016	g2668745	BLASTN	1223	1e-110	98
6887	107	700356050H1	SATMON024	g2668745	BLASTN	1430	1e-110	100
6888	107	701181128H1	SATMONN06	g2668745	BLASTN	1368	1e-105	98
6889	107	700349795H1	SATMON023	g2668745	BLASTN	1370	1e-105	95
6890	107	700473278H1	SATMON025	g2668745	BLASTN	1355	1e-104	100
6891	107	700157057H1	SATMON012	g2668745	BLASTN	1345	1e-103	100
6892	107	700622505H1	SATMON034	g2668745	BLASTN	762	1e-100	96
6893	107	700219661H1	SATMON011	g2668745	BLASTN	942	1e-98	99
6894	107	700619032H1	SATMON034	g2668745	BLASTN	989	1e-98	96
6895	107	700620065H1	SATMON034	g2668745	BLASTN	1069	1e-98	94
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6897	107	700156773H1	SATMON012	g2668745	BLASTN	1276	1e-97	99
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6899	107	700030407H1	SATMON003	g2668745	BLASTN	480	1e-95	98
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6901	107	700195681H1	SATMON014	g2668745	BLASTN	1246	1e-95	99
6902	107	700444838H1	SATMON027	g2668745	BLASTN	1249	1e-95	96

6903	107	700581619H1	SATMON031	g2668745	BLASTN	943	1e-94	96
6904	107	700351021H1	SATMON023	g2668745	BLASTN	853	1e-91	92
6905	107	700205723H1	SATMON003	g2668745	BLASTN	1138	1e-91	95
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6908	107	700336255H1	SATMON019	g2668745	BLASTN	489	1e-85	94
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6910	107	700347429H1	SATMON023	g2668745	BLASTN	891	1e-83	92
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6925	107	700194777H1	SATMON014	g2668745	BLASTN	940	1e-69	100
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6930	107	700102133H1	SATMON010	g2668745	BLASTN	850	1e-62	100
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6940	107	700623602H1	SATMON034	g2668745	BLASTN	460	1e-38	100
6941	107	700612844H1	SATMON033	g2668745	BLASTN	421	1e-36	84
6942	107	700621062H2	SATMON034	g2668745	BLASTN	285	1e-25	89
6943	107	700335685H1	SATMON019	g2668745	BLASTN	339	1e-25	91
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6945	1381	700455149H1	SATMON029	g1747293	BLASTN	836	1e-66	84
6946	1381	700455537H1	SATMON029	g1747293	BLASTN	330	1e-	

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6958	18427	700355977H1	SATMON024	g1747295	BLASTN	1056	1e-81	92
6959	18427	700265262H1	SATMON017	g1747295	BLASTN	626	1e-77	90
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6961	20656	700571658H1	SATMON030	g1747295	BLASTN	480	1e-29	84
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6963	21076	700241354H1	SATMON010	g166634	BLASTX	201	1e-20	58
6964	21267	700050595H1	SATMON003	g1747293	BLASTN	445	1e-32	83
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6971	2531	700155869H1	SATMON007	g2570500	BLASTN	385	1e-27	89
6972	2531	700575534H1	SATMON030	g2570500	BLASTN	365	1e-26	88
6973	2531	700163562H1	SATMON013	g2570501	BLASTX	145	1e-24	94
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6978	2544	700050516H1	SATMON003	g1747295	BLASTN	574	1e-75	91
6979	2544	700620486H1	SATMON034	g1049254	BLASTN	734	1e-54	94
6980	293	700474550H1	SATMON025	g1049254	BLASTN	1359	1e-110	97
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6985	293	700051815H1	SATMON003	g1049254	BLASTN	1256	1e-95	96
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6988	293	700457170H1	SATMON029	g1049254	BLASTN	1198	1e-91	93
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6992	293	700551082H1	SATMON022	g1747293	BLASTN	1151	1e-87	92
6993	293	700156615H1	SATMON012	g1049254	BLASTN	1152	1e-87	94
6994	293	700161538H1	SATMON012	g1049254	BLASTN	1143	1e-86	98
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6998	293	700622261H1	SATMON034	g1049254	BLASTN	614	1e-76	97
6999	293	700043120H1	SATMON004	g1747293	BLASTN	1014	1e-75	87
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7011	293	700456962H1	SATMON029	g1747293	BLASTN	496	1e-61	78
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7016	293	700162157H1	SATMON012	g1747294	BLASTX	185	1e-18	97
7017	293	700162372H1	SATMON012	g1049255	BLASTX	132	1e-10	100
7018	3131	700624482H1	SATMON034	g1747295	BLASTN	1155	1e-95	87
7019	3131	700075221H1	SATMON007	g1747295	BLASTN	1228	1e-93	89
7020	3131	700213731H1	SATMON016	g1747295	BLASTN	1095	1e-84	89
7021	3131	700215864H1	SATMON016	g1747295	BLASTN	1120	1e-84	90
7022	3131	700465076H1	SATMON025	g1747295	BLASTN	1084	1e-81	89
7023	3131	700077092H1	SATMON007	g1747295	BLASTN	998	1e-74	83
7024	32364	700204306H1	SATMON003	g2668745	BLASTN	471	1e-28	74
7025	32671	700451634H1	SATMON028	g1747293	BLASTN	578	1e-73	87
7026	32856	700166756H1	SATMON013	g534915	BLASTN	744	1e-53	76
7027	32856	700042535H1	SATMON004	g534915	BLASTN	644	1e-44	73
7028	337	700242009H1	SATMON010	g1747293	BLASTN	1049	1e-78	90
7029	337	700624035H1	SATMON034	g1747293	BLASTN	1008	1e-75	85
7030	337	700266136H1	SATMON017	g1747293	BLASTN	999	1e-74	84
7031	337	700220713H1	SATMON011	g1747293	BLASTN	752	1e-56	90
7032	3384	700237775H1	SATMON010	g2258073	BLASTN	911	1e-67	81
7033	3384	700342456H1	SATMON021	g2258073	BLASTN	648	1e-64	78
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7035	3384	700577805H1	SATMON031	g2258073	BLASTN	840	1e-61	78
7036	3384	700028881H1	SATMON003	g534915	BLASTN	835	1e-60	78
7037	3384	700215076H1	SATMON016	g534915	BLASTN	824	1e-59	78
7038	3384	700017479H1	SATMON001	g534915	BLASTN	766	1e-55	80
7039	3384	700204495H1	SATMON003	g534915	BLASTN	373	1e-51	81
7040	3384	700196795H1	SATMON014	g2570500	BLASTN	579	1e-39	80
7041	3384	700018612H1	SATMON001	g2668745	BLASTN	518	1e-34	76
7042	3384	700102142H1	SATMON010	g2668745	BLASTN	539	1e-34	78
7043	3384	700348430H1	SATMON023	g534915	BLASTN	489	1e-30	78
7044	3384	700439515H1	SATMON026	g534915	BLASTN	437	1e-27	75
7045	3384	700074977H1	SATMON007	g534915	BLASTN	434	1e-25	76
7046	3384	700023120H1	SATMON003	g534916	BLASTX	208	1e-22	78
7047	3384	700615213H1	SATMON033	g2570501	BLASTX	125	1e-21	93
7048	3384	700074109H1	SATMON007	g2668746	BLASTX	197	1e-20	72
7049	3384	700026094H1	SATMON003	g534916	BLASTX	184	1e-18	75
7050	3384	700549517H1	SATMON022	g2668746	BLASTX	172	1e-17	75
7051	3384	700030347H1	SATMON003	g2668746	BLASTX	171	1e-16	77
7052	3384	700221176H1	SATMON011	g2668746	BLASTX	171	1e-16	77
7053	3384	700433360H1	SATMONN01	g2668746	BLASTX	95	1e-13	74
7054	3817	700047790H1	SATMON003	g1747295	BLASTN	412	1e-57	85
7055	3817	700266224H1	SATMON017	g1747295	BLASTN	473	1e-50	85
7056	3817	700209335H1	SATMON016	g1747295	BLASTN	503	1e-42	86
7057	3817	700089769H1	SATMON011	g1747295	BLASTN	487	1e-40	85
7058	3817	700151762H1	SATMON007	g1747295	BLASTN	457	1e-37	87
7059	3817	700449259H1	SATMON028	g1747295	BLASTN	339	1e-19	81
7060	5000	700026151H1	SATMON003	g2903	BLASTX	261	1e-28	54
7061	5000	700347165H1	SATMON021	g2624379	BLASTX	223	1e-24	51
7062	5000	700430341H1	SATMONN01	g2903	BLASTX	185	1e-18	56
7063	5000	700457781H1	SATMON029	g2903	BLASTX	133	1e-16	49
7064	5861	700104993H1	SATMON010	g2258073	BLASTN	456	1e-27	73

7065	5861	700203452H1	SATMON003	g2258073	BLASTN	428	1e-26	72
7066	5861	700105585H1	SATMON010	g534916	BLASTX	149	1e-13	84
7067	5861	700240805H1	SATMON010	g534916	BLASTX	131	1e-11	82
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7069	5861	700217859H1	SATMON016	g534916	BLASTX	120	1e-9	82
7070	6315	700473069H1	SATMON025	g1747295	BLASTN	1200	1e-91	89
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7075	6315	700165715H1	SATMON013	g1747295	BLASTN	494	1e-63	89
7076	6315	700352887H1	SATMON024	g1747295	BLASTN	606	1e-41	86
7077	707	700206525H1	SATMON003	g1747295	BLASTN	1386	1e-106	91
7078	707	700096774H1	SATMON008	g1747295	BLASTN	1264	1e-96	90
7079	707	700466734H1	SATMON025	g1747295	BLASTN	1078	1e-89	90
7080	707	700332548H1	SATMON019	g1747295	BLASTN	1179	1e-89	89
7081	707	700085122H1	SATMON011	g1747295	BLASTN	1171	1e-88	92
7082	707	700207180H1	SATMON017	g1747295	BLASTN	1159	1e-87	88
7083	707	700333910H1	SATMON019	g1747295	BLASTN	1134	1e-85	92
7084	707	700223824H1	SATMON011	g1747295	BLASTN	1122	1e-84	91
7085	707	700222034H1	SATMON011	g1747295	BLASTN	1102	1e-82	88
7086	707	700570554H1	SATMON030	g1747295	BLASTN	848	1e-81	86
7087	707	700241783H1	SATMON010	g1747295	BLASTN	1090	1e-81	89
7088	707	700224305H1	SATMON011	g1747295	BLASTN	1031	1e-77	85
7089	707	700458382H1	SATMON029	g1747295	BLASTN	993	1e-73	89
7090	707	700151266H1	SATMON007	g1747295	BLASTN	671	1e-47	86
7091	707	700470565H1	SATMON025	g1747295	BLASTN	404	1e-46	86
7092	707	700207802H1	SATMON016	g1747295	BLASTN	543	1e-43	87
7093	7540	700049926H1	SATMON003	g1747295	BLASTN	718	1e-50	87
7094	7540	700458612H1	SATMON029	g1747295	BLASTN	670	1e-46	83
7095	-L1431590	LIB143-006-Q1-E1-C9	LIB143	g16347	BLASTN	286	1e-13	61
7096	-L1433414	LIB143-026-Q1-E1-C3	LIB143	g2258073	BLASTN	480	1e-29	70
7097	-L1482832	LIB148-009-Q1-E1-D8	LIB148	g2258073	BLASTN	1086	1e-81	78
7098	-L30593394	LIB3059-029-Q1-K1-A12	LIB3059	g1747295	BLASTN	488	1e-91	82
7099	-L30593582	LIB3059-031-Q1-K1-C7	LIB3059	g1747293	BLASTN	807	1e-71	86
7100	-L30674379	LIB3067-042-Q1-K1-H8	LIB3067	g2668745	BLASTN	305	1e-21	68
7101	-L30675338	LIB3067-035-Q1-K1-H12	LIB3067	g1747293	BLASTN	436	1e-25	80
7102	-L30784040	LIB3078-029-Q1-K1-D6	LIB3078	g1747293	BLASTN	523	1e-53	70
7103	107	LIB3059-036-Q1-K1-B10	LIB3059	g2668745	BLASTN	1965	1e-166	100
7104	107	LIB3061-035-Q1-K1-C9	LIB3061	g2668745	BLASTN	948	1e-138	93
7105	107	LIB3061-032-Q1-K1-A12	LIB3061	g2668745	BLASTN	1685	1e-138	96
7106	107	LIB3062-044-Q1-K1-F8	LIB3062	g2668745	BLASTN	1492	1e-134	95



7107	107	LIB3068-025- Q1-K1-E5	LIB3068	g2668745	BLASTN	1687	1e-132	96
7108	107	LIB3067-022- Q1-K1-D11	LIB3067	g2668745	BLASTN	1581	1e-128	91
7109	107	LIB3067-016- Q1-K1-G4	LIB3067	g2668745	BLASTN	1305	1e-126	97
7110	107	LIB3067-029- Q1-K1-C6	LIB3067	g2668745	BLASTN	1560	1e-125	90
7111	107	LIB189-031- Q1-E1-D3	LIB189	g2668745	BLASTN	897	1e-81	85
7112	24066	LIB3069-047- Q1-K1-C4	LIB3069	g166634	BLASTX	173	1e-45	55
7113	24266	LIB3069-006- Q1-K1-F4	LIB3069	g2570500	BLASTN	717	1e-57	83
7114	293	LIB3060-032- Q1-K1-D3	LIB3060	g1049254	BLASTN	2144	1e-170	97
7115	293	LIB3066-051- Q1-K1-D3	LIB3066	g1049254	BLASTN	1603	1e-158	99
7116	293	LIB3060-026- Q1-K1-G5	LIB3060	g1049254	BLASTN	1642	1e-155	92
7117	293	LIB143-018- Q1-E1-D7	LIB143	g1049254	BLASTN	1249	1e-151	99
7118	293	LIB189-005- Q1-E1-G2	LIB189	g1049254	BLASTN	1911	1e-150	98
7119	293	LIB3059-035- Q1-K1-G7	LIB3059	g1049254	BLASTN	1860	1e-146	89
7120	293	LIB3060-013- Q1-K1-D3	LIB3060	g1049254	BLASTN	1236	1e-144	95
7121	293	LIB3060-010- Q1-K1-G9	LIB3060	g1049254	BLASTN	1171	1e-142	90
7122	293	LIB143-031- Q1-E1-F9	LIB143	g1049254	BLASTN	1777	1e-139	97
7123	293	LIB3067-034- Q1-K1-B4	LIB3067	g1049254	BLASTN	1558	1e-121	93
7124	293	LIB3067-010- Q1-K1-A11	LIB3067	g1049254	BLASTN	901	1e-120	90
7125	293	LIB3060-015- Q1-K1-G3	LIB3060	g1049254	BLASTN	1309	1e-106	87
7126	293	LIB3059-024- Q1-K1-G11	LIB3059	g1049254	BLASTN	1255	1e-95	98
7127	293	LIB3060-038- Q1-K1-B1	LIB3060	g1049254	BLASTN	1109	1e-83	87
7128	293	LIB143-008- Q1-E1-B6	LIB143	g1747293	BLASTN	1042	1e-77	85
7129	293	LIB143-021- Q1-E1-A12	LIB143	g1747293	BLASTN	951	1e-70	84
7130	293	LIB143-037- Q1-E1-C3	LIB143	g1747293	BLASTN	858	1e-68	89
7131	293	LIB3079-004- Q1-K1-D5	LIB3079	g1747293	BLASTN	826	1e-59	83
7132	293	LIB143-028- Q1-E1-F3	LIB143	g1747293	BLASTN	598	1e-40	88
7133	293	LIB3068-043- Q1-K1-A2	LIB3068	g633598	BLASTN	552	1e-34	78

7134	3131	LIB3066-031-Q1-K1-E3	LIB3066	g1747295	BLASTN	1114	1e-98	85
7135	31637	LIB143-001-Q1-E1-G11	LIB143	g1747293	BLASTN	472	1e-74	81
7136	32364	LIB3066-001-Q1-K1-B7	LIB3066	g2668745	BLASTN	612	1e-40	73
7137	32671	LIB143-061-Q1-E1-E10	LIB143	g1747293	BLASTN	1414	1e-116	85
7138	32671	LIB189-020-Q1-E1-C10	LIB189	g1747293	BLASTN	1281	1e-97	86
7139	32856	LIB189-028-Q1-E1-C4	LIB189	g534915	BLASTN	986	1e-73	73
7140	3384	LIB143-026-Q1-E1-C1	LIB143	g534915	BLASTN	1284	1e-98	78
7141	3384	LIB3068-013-Q1-K1-H2	LIB3068	g534915	BLASTN	1074	1e-80	78
7142	3384	LIB3062-033-Q1-K1-D2	LIB3062	g2668745	BLASTN	1009	1e-75	76
7143	3384	LIB3062-057-Q1-K1-B7	LIB3062	g2668745	BLASTN	801	1e-58	73
7144	3384	LIB3062-001-Q1-K2-H5	LIB3062	g16347	BLASTN	802	1e-57	77
7145	3384	LIB189-022-Q1-E1-D5	LIB189	g2668745	BLASTN	646	1e-43	75
7146	3384	LIB189-012-Q1-E1-F4	LIB189	g2570501	BLASTX	138	1e-32	72
7147	5000	LIB36-015-Q1-E1-D6	LIB36	g2624379	BLASTX	236	1e-41	51
7148	5000	LIB83-016-Q1-E1-H7	LIB83	g4198	BLASTN	534	1e-33	61
7149	707	LIB148-019-Q1-E1-H8	LIB148	g1747295	BLASTN	1506	1e-116	89
7150	707	LIB3066-040-Q1-K1-D6	LIB3066	g1747295	BLASTN	1459	1e-112	82
7151	707	LIB148-004-Q1-E1-B10	LIB148	g1747295	BLASTN	1268	1e-109	84
7152	707	LIB3068-036-Q1-K1-A10	LIB3068	g1747295	BLASTN	889	1e-102	83
7153	7540	LIB143-025-Q1-E1-C10	LIB143	g1747295	BLASTN	903	1e-66	86
7154	7540	LIB148-033-Q1-E1-A7	LIB148	g1747295	BLASTN	857	1e-65	87

#### SOYBEAN PYROPHOSPHATASE

Seq No.	Cluster ID	CloneID	Library	NCBI gi	Method	Score	P-value	%Ident
7155	-700651291	700651291H1	SOYMON003	g1049254	BLASTN	732	1e-52	84
7156	-700652792	700652792H1	SOYMON003	g2653445	BLASTN	474	1e-39	88
7157	-700656683	700656683H1	SOYMON004	g1747293	BLASTN	679	1e-59	84
7158	-700660662	700660662H1	SOYMON004	g16347	BLASTN	540	1e-36	79
7159	-700744202	700744202H1	SOYMON013	g485741	BLASTN	554	1e-44	74
7160	-700755514	700755514H1	SOYMON014	g1747293	BLASTN	743	1e-53	78
7161	-700837007	700837007H1	SOYMON020	g16347	BLASTN	776	1e-55	78
7162	-700865679	700865679H1	SOYMON016	g2653445	BLASTN	250	1e-36	92

7163	-700890647	700890647H1	SOYMON024	g790474	BLASTN	826	1e-60	81
7164	-700942978	700942978H1	SOYMON024	g790478	BLASTN	605	1e-63	82
7165	-700944280	700944280H1	SOYMON024	g790479	BLASTX	119	1e-10	76
7166	-700974544	700974544H1	SOYMON005	g1103711	BLASTN	854	1e-62	83
7167	-700984449	700984449H1	SOYMON009	g1103711	BLASTN	287	1e-12	71
7168	-700989248	700989248H1	SOYMON011	g534915	BLASTN	276	1e-14	67
7169	-701002440	701002440H1	SOYMON018	g2653445	BLASTN	784	1e-56	76
7170	-701003295	701003295H1	SOYMON019	g1049255	BLASTX	73	1e-8	53
7171	-701012101	701012101H1	SOYMON019	g2653445	BLASTN	592	1e-40	77
7172	-701097188	701097188H1	SOYMON028	g2653445	BLASTN	557	1e-37	75
7173	-701105007	701105007H1	SOYMON036	g2653445	BLASTN	455	1e-61	86
7174	-701106870	701106870H1	SOYMON036	g790478	BLASTN	623	1e-47	75
7175	-701122796	701122796H1	SOYMON037	g2258074	BLASTX	71	1e-15	73
7176	-701124682	701124682H1	SOYMON037	g485743	BLASTN	713	1e-50	81
7177	-701132123	701132123H1	SOYMON038	g790478	BLASTN	627	1e-43	81
7178	-701136557	701136557H1	SOYMON038	g16347	BLASTN	376	1e-33	77
7179	-701148551	701148551H1	SOYMON031	g2653445	BLASTN	756	1e-54	78
7180	-701206188	701206188H1	SOYMON035	g166633	BLASTN	399	1e-48	81
7181	-701211207	701211207H1	SOYMON035	g2653445	BLASTN	387	1e-28	77
7182	11662	700987644H1	SOYMON009	g1747294	BLASTX	122	1e-17	60
7183	13047	700955418H1	SOYMON022	g2653445	BLASTN	585	1e-82	91
7184	13047	701054053H1	SOYMON032	g2653445	BLASTN	1080	1e-81	87
7185	13047	700846717H1	SOYMON021	g2653445	BLASTN	1000	1e-79	91
7186	13047	700952212H1	SOYMON022	g2653445	BLASTN	1055	1e-79	90
7187	13047	701156608H1	SOYMON031	g2653445	BLASTN	648	1e-78	91
7188	13047	700959847H1	SOYMON022	g2653445	BLASTN	932	1e-76	91
7189	13047	700986383H1	SOYMON009	g2653445	BLASTN	1029	1e-76	87
7190	13047	700892594H1	SOYMON024	g2653445	BLASTN	1005	1e-74	87
7191	13047	700995882H1	SOYMON011	g2653445	BLASTN	515	1e-68	90
7192	13047	701099843H1	SOYMON028	g2653445	BLASTN	850	1e-61	90
7193	14021	700973215H1	SOYMON005	g2668745	BLASTN	435	1e-39	80
7194	14021	701109310H1	SOYMON036	g2668745	BLASTN	281	1e-25	83
7195	14021	700847609H1	SOYMON021	g534916	BLASTX	98	1e-12	74
7196	14580	700952058H1	SOYMON022	g2653445	BLASTN	954	1e-70	88
7197	14580	700756103H1	SOYMON014	g2653445	BLASTN	562	1e-66	84
7198	15316	700847173H1	SOYMON021	g534916	BLASTX	123	1e-10	66
7199	15316	700847165H1	SOYMON021	g534916	BLASTX	121	1e-9	66
7200	15698	700844601H1	SOYMON021	g2653445	BLASTN	976	1e-72	91
7201	15698	700904602H1	SOYMON022	g2653445	BLASTN	466	1e-62	85
7202	15698	701002118H1	SOYMON018	g2653445	BLASTN	860	1e-62	87
7203	16	701044831H1	SOYMON032	g485744	BLASTX	163	1e-17	73
7204	16	700891764H1	SOYMON024	g790479	BLASTX	172	1e-16	68
7205	16	700953633H1	SOYMON022	g485744	BLASTX	161	1e-15	73
7206	16	700753981H1	SOYMON014	g485744	BLASTX	159	1e-14	70
7207	16	701104248H1	SOYMON036	g485744	BLASTX	57	1e-8	68
7208	1820	700888545H1	SOYMON024	g2653445	BLASTN	271	1e-39	84
7209	1820	700954577H1	SOYMON022	g2653445	BLASTN	177	1e-37	80
7210	1820	700869270H1	SOYMON016	g2653445	BLASTN	173	1e-16	80
7211	1820	700792533H1	SOYMON017	g2653445	BLASTN	182	1e-15	80
7212	1820	700734996H1	SOYMON010	g2653445	BLASTN	173	1e-14	78
7213	19232	701061126H1	SOYMON033	g790474	BLASTN	935	1e-69	81
7214	19232	700962864H1	SOYMON022	g790474	BLASTN	874	1e-64	82
7215	20872	700754883H1	SOYMON014	g790478	BLASTN	824	1e-59	81
7216	20872	700971147H1	SOYMON005	g1103711	BLASTN	564	1e-54	79

7217	20885	700904547H1	SOYMON022	g485743	BLASTN	971	1e-72	86
7218	20885	700665391H1	SOYMON005	g485743	BLASTN	969	1e-71	86
7219	20885	700941185H1	SOYMON024	g2653445	BLASTN	868	1e-63	83
7220	20885	700660695H1	SOYMON004	g2653445	BLASTN	825	1e-59	85
7221	20885	701127185H1	SOYMON037	g1747293	BLASTN	463	1e-54	83
7222	24940	701209525H1	SOYMON035	g2653445	BLASTN	789	1e-56	91
7223	24940	701213556H1	SOYMON035	g2653445	BLASTN	574	1e-38	93
7224	27239	700668618H1	SOYMON006	g1049255	BLASTX	179	1e-17	61
7225	2813	700797861H1	SOYMON017	g16347	BLASTN	731	1e-52	79
7226	2813	700944850H1	SOYMON024	g2570500	BLASTN	738	1e-52	82
7227	2813	701056207H1	SOYMON032	g2570500	BLASTN	556	1e-46	80
7228	2813	700605115H2	SOYMON003	g2570500	BLASTN	478	1e-42	80
7229	2813	700897063H1	SOYMON027	g2570500	BLASTN	596	1e-40	80
7230	2813	700561829H1	SOYMON002	g2570500	BLASTN	570	1e-38	80
7231	2813	701204883H1	SOYMON035	g2668745	BLASTN	545	1e-36	77
7232	2813	700754984H1	SOYMON014	g2570500	BLASTN	527	1e-35	75
7233	2813	700854552H1	SOYMON023	g2570500	BLASTN	536	1e-35	79
7234	2813	700873337H1	SOYMON018	g2570500	BLASTN	505	1e-33	75
7235	2813	700873349H1	SOYMON018	g2570500	BLASTN	506	1e-33	75
7236	2813	700952403H1	SOYMON022	g2668745	BLASTN	499	1e-32	76
7237	2813	700846561H1	SOYMON021	g2570500	BLASTN	488	1e-31	75
7238	2813	700953987H1	SOYMON022	g2570500	BLASTN	461	1e-29	75
7239	2813	700568667H1	SOYMON002	g2570500	BLASTN	296	1e-24	79
7240	2813	700895231H1	SOYMON024	g2258074	BLASTX	207	1e-22	80
7241	2813	701101791H1	SOYMON028	g2668746	BLASTX	147	1e-13	77
7242	4106	701011114H1	SOYMON019	g2653445	BLASTN	904	1e-76	90
7243	4106	700674046H1	SOYMON007	g2653445	BLASTN	989	1e-73	90
7244	4106	700967038H1	SOYMON029	g2653445	BLASTN	963	1e-71	90
7245	4106	700740792H1	SOYMON012	g2653445	BLASTN	911	1e-67	90
7246	4106	700872817H1	SOYMON018	g2653445	BLASTN	903	1e-66	89
7247	4106	700738286H1	SOYMON012	g2653446	BLASTX	95	1e-10	91
7248	4845	700566516H1	SOYMON002	g2653445	BLASTN	1358	1e-104	94
7249	4845	700978728H1	SOYMON009	g2653445	BLASTN	917	1e-88	95
7250	4845	700907549H1	SOYMON022	g2653445	BLASTN	1168	1e-88	94
7251	4845	700908149H1	SOYMON022	g2653445	BLASTN	1156	1e-87	92
7252	4845	700559351H1	SOYMON001	g2653445	BLASTN	973	1e-86	90
7253	4845	700898914H1	SOYMON027	g2653445	BLASTN	1140	1e-86	93
7254	4845	700946269H1	SOYMON024	g2653445	BLASTN	1132	1e-85	91
7255	4845	701011513H1	SOYMON019	g2653445	BLASTN	1124	1e-84	92
7256	4845	700785951H2	SOYMON011	g2653445	BLASTN	1114	1e-83	92
7257	4845	701003561H1	SOYMON019	g2653445	BLASTN	1093	1e-82	92
7258	4845	700755340H1	SOYMON014	g2653445	BLASTN	1097	1e-82	93
7259	4845	700756774H1	SOYMON014	g2653445	BLASTN	950	1e-81	92
7260	4845	700564820H1	SOYMON002	g2653445	BLASTN	989	1e-81	87
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7262	4845	700970334H1	SOYMON005	g2653445	BLASTN	978	1e-77	86
7263	4845	700656490H1	SOYMON004	g2653445	BLASTN	941	1e-73	91
7264	4845	700871681H1	SOYMON018	g2653445	BLASTN	974	1e-72	92
7265	4845	701153255H1	SOYMON031	g2653445	BLASTN	758	1e-65	94
7266	4845	701049483H1	SOYMON032	g2653445	BLASTN	865	1e-65	88
7267	4845	700796611H1	SOYMON017	g2653445	BLASTN	577	1e-59	86
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7269	4845	700795148H1	SOYMON017	g2653445	BLASTN	631	1e-57	83
7270	4845	701099340H1	SOYMON028	g2653445	BLASTN	678	1e-47	86

7271	4845	201097793H1	SOYMON028	g2653445	BLASTN	571	1e-38	88
7272	5440	701049119H1	SOYMON032	g2653445	BLASTN	1116	1e-84	89
7273	5440	701135152H1	SOYMON038	g2653445	BLASTN	703	1e-72	90
7274	5440	701001376H1	SOYMON018	g2653445	BLASTN	611	1e-67	89
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7277	5440	700844506H1	SOYMON021	g2653445	BLASTN	838	1e-60	87
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7280	5440	700794050H1	SOYMON017	g2653445	BLASTN	793	1e-57	84
7281	5440	700952580H1	SOYMON022	g2653445	BLASTN	798	1e-57	88
7282	5440	700563827H1	SOYMON002	g2653445	BLASTN	735	1e-56	82
7283	5440	700952567H1	SOYMON022	g2653445	BLASTN	783	1e-56	88
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7286	5440	700686154H1	SOYMON008	g2653445	BLASTN	458	1e-48	84
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7288	5440	700952870H1	SOYMON022	g2653445	BLASTN	685	1e-48	87
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7290	5440	701210118H1	SOYMON035	g2653445	BLASTN	418	1e-45	85
7291	5440	700906779H1	SOYMON022	g2653445	BLASTN	631	1e-43	84
7292	5440	700833390H1	SOYMON019	g2653445	BLASTN	239	1e-36	87
7293	5440	700990989H1	SOYMON011	g2653445	BLASTN	545	1e-36	85
7294	5440	701103017H1	SOYMON028	g2653445	BLASTN	439	1e-27	85
7295	5440	700978736H1	SOYMON009	g2653446	BLASTX	124	1e-16	57
7296	7894	700795920H1	SOYMON017	g2653445	BLASTN	1016	1e-75	87
7297	7894	700888375H1	SOYMON024	g2653445	BLASTN	742	1e-66	88
7298	8040	701121224H1	SOYMON037	g534915	BLASTN	298	1e-14	77
7299	8040	700743066H1	SOYMON012	g2668746	BLASTX	140	1e-12	80
7300	8531	701005139H1	SOYMON019	g2258073	BLASTN	871	1e-63	79
7301	8531	701008308H1	SOYMON019	g534915	BLASTN	789	1e-57	76
7302	8531	700559054H1	SOYMON001	g2570500	BLASTN	790	1e-57	77
7303	8531	700790983H1	SOYMON011	g2258073	BLASTN	431	1e-52	77
7304	8531	701007949H1	SOYMON019	g2570500	BLASTN	404	1e-41	70
7305	8531	701123827H1	SOYMON037	g534915	BLASTN	436	1e-26	75
7306	8531	701013616H1	SOYMON019	g534915	BLASTN	431	1e-25	78
7307	8531	701013624H1	SOYMON019	g534916	BLASTX	210	1e-22	84
7308	8531	700888553H1	SOYMON024	g534916	BLASTX	174	1e-17	91
7309	8531	701106256H1	SOYMON036	g534916	BLASTX	174	1e-17	84
7310	8531	701214976H1	SOYMON035	g534916	BLASTX	165	1e-16	88
7311	8531	700565624H1	SOYMON002	g2570501	BLASTX	169	1e-16	85
7312	8531	701121092H1	SOYMON037	g2570501	BLASTX	110	1e-15	60
7313	8531	700788808H2	SOYMON011	g534916	BLASTX	159	1e-15	88
7314	853							

7325	9059	700751040H1	SOYMON014	g2653445	BLASTN	872	1e-63	86
7326	9059	700957555H1	SOYMON022	g2653445	BLASTN	565	1e-40	86
7327	13047	LIB3028-012-Q1-B1-B8	LIB3028	g2653445	BLASTN	1120	1e-116	89
7328	13047	LIB3028-012-Q1-B1-A6	LIB3028	g2653445	BLASTN	1424	1e-115	91
7329	16	LIB3040-003-Q1-E1-F6	LIB3040	g633598	BLASTN	523	1e-51	74
7330	16	LIB3051-114-Q1-K1-G5	LIB3051	g790478	BLASTN	457	1e-48	79
7331	16	LIB3039-020-Q1-E1-A2	LIB3039	g790478	BLASTN	338	1e-30	74
7332	1820	LIB3065-010-Q1-N1-H3	LIB3065	g2653445	BLASTN	173	1e-10	88
7333	20885	LIB3051-070-Q1-K1-B12	LIB3051	g2653445	BLASTN	1058	1e-110	77
7334	27239	LIB3051-010-Q1-E1-G8	LIB3051	g1747293	BLASTN	544	1e-34	73
7335	2813	LIB3028-026-Q1-B1-B7	LIB3028	g2570500	BLASTN	1029	1e-77	80
7336	4845	LIB3039-007-Q1-E1-H3	LIB3039	g2653445	BLASTN	1826	1e-143	94
7337	4845	LIB3050-012-Q1-E1-B11	LIB3050	g2653445	BLASTN	1597	1e-124	91
7338	8040	LIB3049-005-Q1-E1-A7	LIB3049	g2570501	BLASTX	154	1e-32	61
7339	8531	LIB3050-013-Q1-E1-G8	LIB3050	g2570500	BLASTN	748	1e-53	72
7340	8531	LIB3073-025-Q1-K1-D6	LIB3073	g534915	BLASTN	711	1e-49	78
7341	8531	LIB3050-012-Q1-E1-D1	LIB3050	g2258074	BLASTX	93	1e-31	74

## **\*Table Headings**

### **Cluster ID**

A cluster ID is arbitrarily assigned to all of those clones which belong to the same cluster at a given stringency and a particular clone will belong to only one cluster at a given stringency. If a cluster contains only a single clone (a “singleton”), then the cluster ID number will be negative, with an absolute value equal to the clone ID number of its single member. The cluster ID entries in the table refer to the cluster with which the particular clone in each row is associated.

### **Clone ID**

The clone ID number refers to the particular clone in the PhytoSeq database. Each clone ID entry in the table refers to the clone whose sequence is used for (1) the sequence comparison whose scores are presented and/or (2) assignment to the particular cluster which is presented. Note that a clone may be included in this table even if its sequence comparison scores fail to meet the minimum standards for similarity. In such a case, the clone is included due solely to its association with a particular cluster for which sequences of one or more other member clones possess the required level of similarity.

### **Library**

The library ID refers to the particular cDNA library from which a given clone is obtained. Each cDNA library is associated with the particular tissue(s), line(s) and developmental stage(s) from which it is isolated.

### **NCBI gi**

Each sequence in the GenBank public database is arbitrarily assigned a unique NCBI gi (National Center for Biotechnology Information GenBank Identifier) number. In this table, the

NCBI gi number which is associated (in the same row) with a given clone refers to the particular GenBank sequence which is used in the sequence comparison. This entry is omitted when a clone is included solely due to its association with a particular cluster.

### **Method**

The entry in the "Method" column of the table refers to the type of BLAST search that is used for the sequence comparison. "CLUSTER" is entered when the sequence comparison scores for a given clone fail to meet the minimum values required for significant similarity. In such cases, the clone is listed in the table solely as a result of its association with a given cluster for which sequences of one or more other member clones possess the required level of similarity.

### **Score**

Each entry in the "Score" column of the table refers to the BLAST score that is generated by sequence comparison of the designated clone with the designated GenBank sequence using the designated BLAST method. This entry is omitted when a clone is included solely due to its association with a particular cluster. If the program used to determine the hit is HMMSW then the score refers to HMMSW score.

### **P-Value**

The entries in the P-Value column refer to the probability that such matches occur by chance.

### **%Ident**

The entries in the "%Ident" column of the table refer to the percentage of identically matched nucleotides (or residues) that exist along the length of that portion of the sequences which is aligned by the BLAST comparison to generate the statistical scores presented. This entry is omitted when a clone is included solely due to its association with a particular cluster.